Compressed Air Magazine

Vol. XXXIV, No. II London New York Paris 35 Cents a Copy

FEBRUARY, 1929

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(TABLE OF CONTENTS AND ADVERTISERS' INDEX, PAGE 26)

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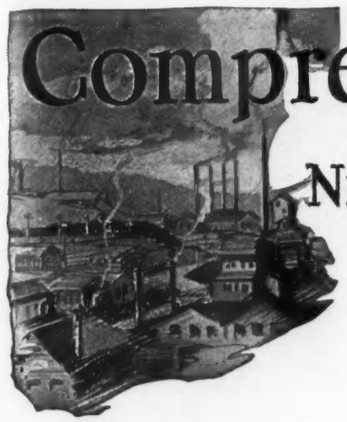

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NEW YORK · LONDON · PARIS

Principal Offices
Bowling Green Building
No. 11 Broadway
New York.

VOL. XXXIV, No. II

FEBRUARY, 1929

Mar Villa Marble for a Monster Business Structure

Great Fisher Building in Detroit, Mich., is Being Faced With Marble from a Historic Source in Maryland

By R. G. SKERRETT

MARYLAND marble was used exclusively in the construction of the first monument reared to General George Washington. The corner stone for that memorial was laid July 4, 1815, in the very heart of the City of Baltimore.

Maryland marble, also from a vein that supplied stone for the shaft just mentioned, is now being utilized for what, in effect, will constitute a monument to America's amazing automobile industry—we refer to the magnificent business building now being erected by the Fisher Brothers in Detroit, Mich.

It may seem a far cry from 1815 to 1928; but the interval of more than a century has served to prove conclusively the exceptional wearing and weathering qualities of the marble that has come from the rightly famous Beaver Dam quarries located in Baltimore County a short distance away from Cockeysville, Md.

Perhaps it would not be out of place here to mention some of the historic structures in which Beaver Dam marble has been used to advantage. For instance, all but 150 feet constituting the lower section of the Washington Monument, in Washington, D. C., is faced with marble from one of the Beaver Dam quarries; and from the same source was obtained, in the early "fifties", the stone for the beautiful, fluted, monolithic columns that adorn the wings of the National Capitol itself. All told, there are 108 of these columns, and each is 26 feet in length. The handsome Senate Office Building in Washington has its facade finished with Beaver Dam marble; and the spires of St. Patrick's Cathedral, in New York City, likewise are built of this effective and enduring material.

With these notable examples of architectural fitness and fineness—really but a few among many, it is not hard to understand why the experts responsible for designing and erecting the Fisher Building should have elected to use marble from a Beaver Dam quarry. The stone chosen, designated as Mar Villa marble, makes a special appeal to the eye because of its color and its veining. To the architect it has the added merit that its crushing strength ranges between 20,000 and 22,000 pounds to the square inch—a strength equal and even superior to that of many well-known granites.

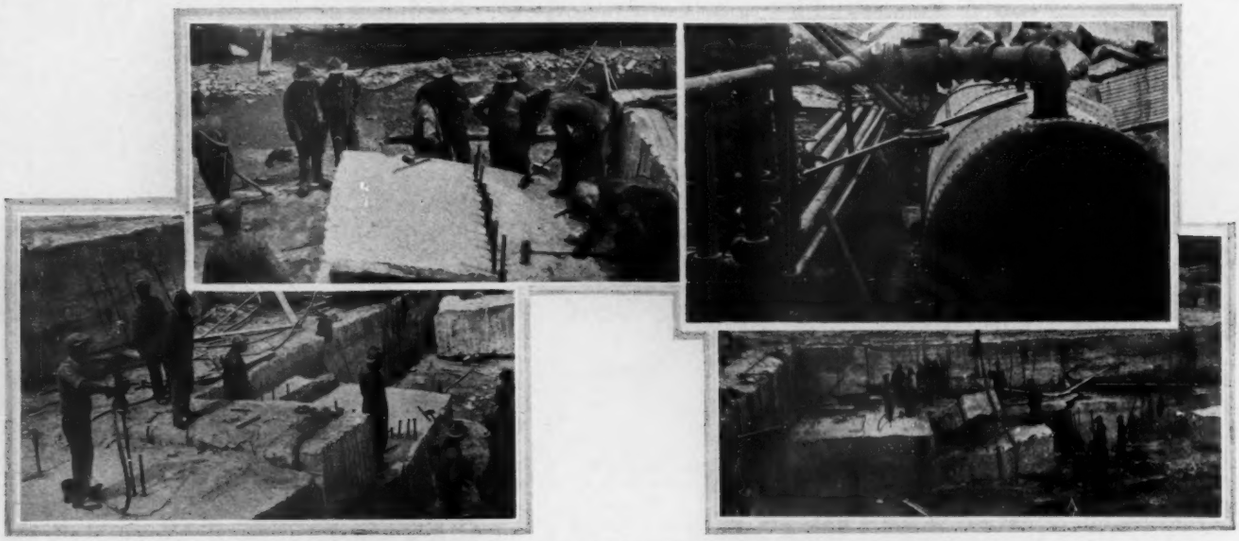
FASHIONS in marble like fashions in dress change with the passing decades; and happily such is the case. For many years, American architects generally insisted upon white marble for most of the imposing structures designed by them. They specified marble of this sort because of classic association and also because of a certain dignified austerity characteristic of the stone.

Among the historic quarries furnishing white marble in the United States were those situated at Beaver Dam, Md.; and to obtain the desired white marble an overlying colored stratum was then scrapped.

Today, this warm and pleasing stone is being quarried for a great business building in Detroit, Mich.; and thus material that was long cast aside is now coming into its own and winning favor.

The technicists made their choice only after an exhaustive examination of various stones available elsewhere for the purpose and also after they had thoroughly satisfied themselves that the Beaver Dam Marble Company was in a position to furnish expeditiously a large quantity of the desired marble. Besides speed of delivery, it was equally important and essential that there should be no doubt about the stratum in question containing enough Mar Villa marble to insure uniformity in the appearance of the whole structure because the first wing unit of the Fisher Building is to be joined later to a great central tower flanked by another wing. This question was answered by the making of exploratory core-drill borings that were carried to a depth of more than 100 feet. These borings disclosed the presence of superior marble of the sort required over an area of many acres.

In the earlier days, quarrying operations at Beaver Dam were conducted in a somewhat leisurely manner; but this procedure had to be radically changed in order to meet the conditions specified in the contract signed October 4, 1927. By that agreement the Beaver Dam Marble Company obligated itself to deliver 100,000 cubic feet of Mar Villa marble in a few months; and final delivery was made on July 18, 1928. Nothing approaching that magnitude had previously been undertaken by the firm. The company's equipment was just about capable of producing 40,000 cubic feet a year; and the problem was to amplify this or to secure different and thoroughly up-to-date facilities. As a



Top, left—Splitting a large block with plugs and feathers. Right—The compressed air for all the pneumatic equipment used in the quarry is drawn from this outdoor receiver. Bottom—Blocks of marble ready for removal to the cutting shed.

matter of fact, the Beaver Dam Marble Company wisely decided to remodel its plant well-nigh completely; and how well the enterprising management met the situation is proved by what it has accomplished.

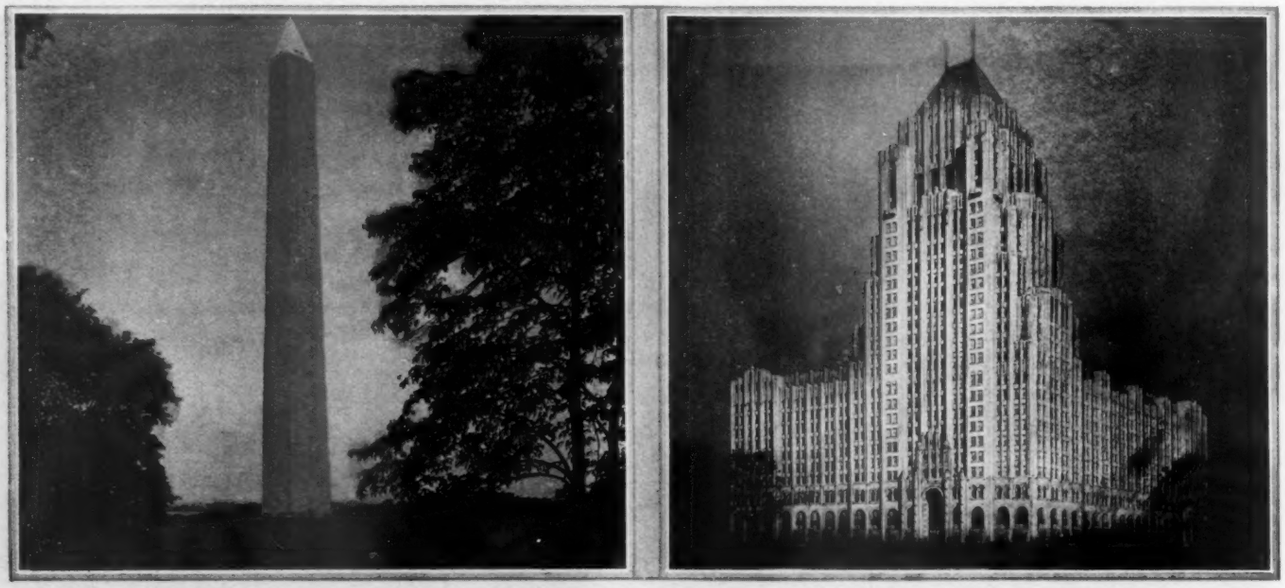
The quarry from which Mar Villa marble is taken lies a few hundred yards north of the pits from which white Beaver Dam marble was obtained for some of the structures to which we have already referred. Architectural periods are just as pronounced as those pertaining to fashion in dress; and for a long while designers insisted upon white marble—beautiful, to be sure, but cold. The stratum of white marble at Beaver Dam lay beneath a deep stratum of colored marble, and, strange as it may seem, this warm and lovely stone was removed and cast aside for decades, like so much useless overburden, in order to reach the lower vein of white marble. Happily, American architects are keenly alive today to the charming effects that can be produced by the use of stones of varied textures and colors. This changed attitude has given value to what once was an unprofitable by-product; and Mar Villa marble—which has been described as softly tinted, golden light brown, mellow, warm, and rich, has come into its own. The stone has a pleasing and a distinctive veining. It is because of its "vital" tone that it is peculiarly suited to play a part in emphasizing the urge and the magnitude of a great and bustling industry.

The quarry from which the Mar Villa marble is being taken is the latest opening made by the Beaver Dam Company. Operations were started there as lately as October of 1927. Since that time the quarry has been efficiently organized and equipped so as to get the stone out quickly, in the first place, and afterwards to handle it promptly for shipment. It would be difficult to imagine a quarry better fitted for the immediate work before it—work that now means furnishing marble for the entire Fisher Building necessitating the production of twice the volume of Mar Villa marble specified in the original contract.

At the start, the Beaver Dam Marble Company contemplated relying in the main

Working face at the quarry showing N-72 rock drills, mounted on quarry bars, getting out great blocks of dimensioned marble.

1—Where the steels for the rock drills and "Jackhamers" used in the Mar Villa quarry are reconditioned. This blacksmith shop is equipped with a No. 50 "Leyner" sharpener, a No. 25 oil furnace, and a pedestal grinder. 2—Drilling a line of "loft" holes with a "Jackhamer" preparatory to breaking the block free with wedges. 3—Compressor plant of the Beaver Dam Marble Company showing two of the three electrically driven machines and the steam-operated unit. 4—Gang saws cutting a block of marble into slabs of the desired thickness. 5—Another view of the quarry when working day and night to complete contract.



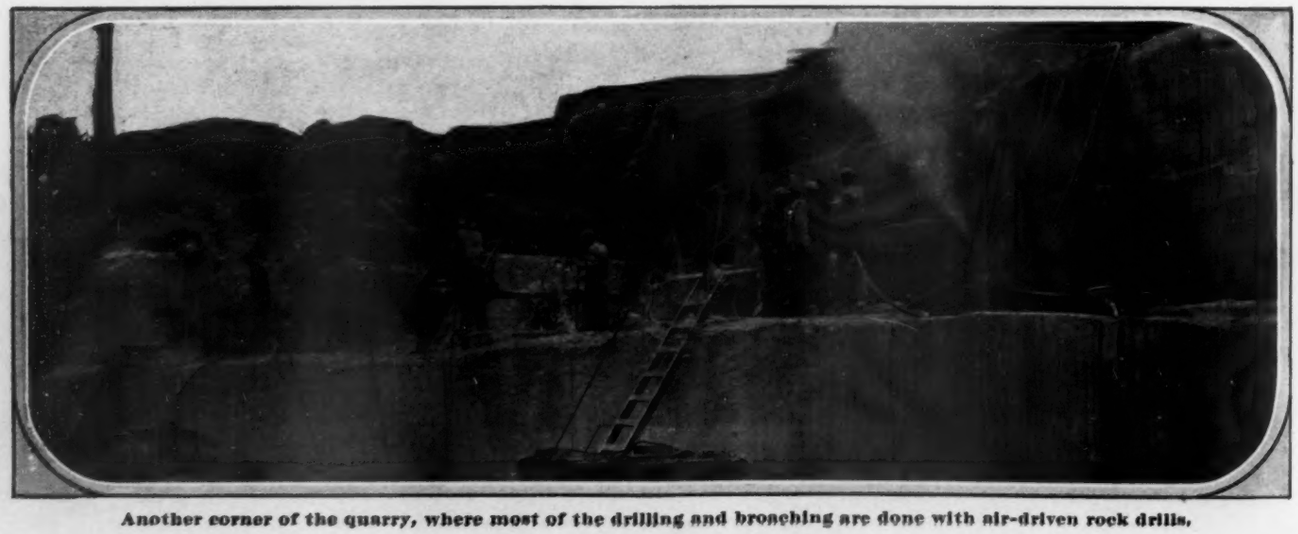
Left—Washington Monument which rises to an impressive height of more than 555 feet. All but 150 feet of this shaft, which was begun in 1815, is faced with white marble from the Beaver Dam quarries. Right—The same quarries, in Maryland, are today supplying Mar Villa marble for this magnificent structure being reared by the Fisher Brothers in Detroit, Mich.

upon steam-driven channelers to cut the quarry floor to a depth of 8 feet 6 inches; but it was not long before the management realized that this procedure would not answer. Therefore, it decided to utilize channelers only for certain cuts—especially those close to the quarry walls and a few others, such as the "key-block" rows. The rest of the block cutting is done with N-72 air-driven rock drills. Two of these drills, mounted on a heavy quarry bar, constitute a working unit. The N-72's drill a line of closely spaced holes to the desired depth, and then the cores or bridges between the holes are broken down with a broaching steel fitted to the same drills. Owing to their lighter weight and to the ease with which they can be shifted, these outfits have proved generally better adapted for the purpose than steam channelers.

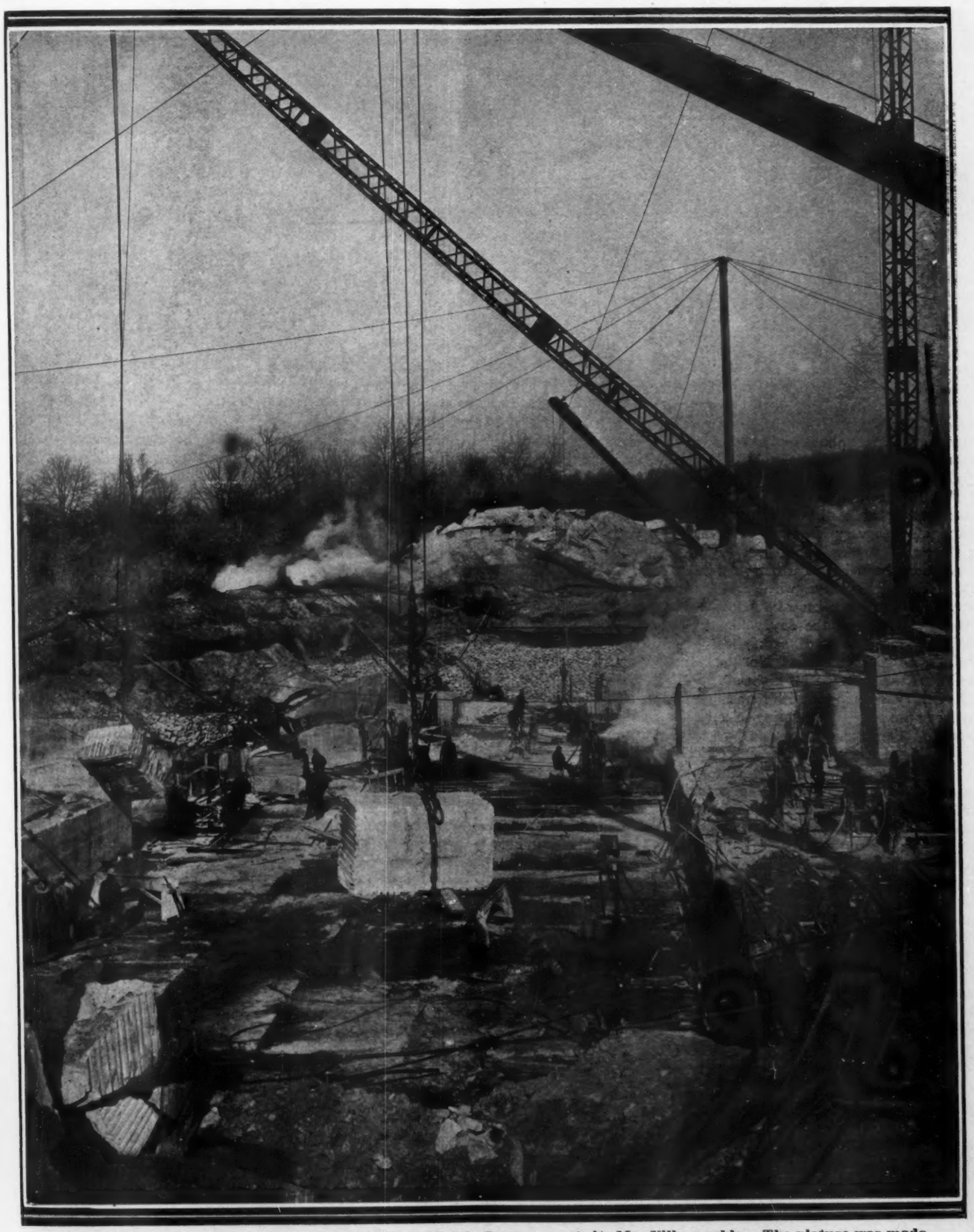
In opening up a floor or widely separated parts of a floor, the first operation is to get out the key block so as to provide a pit large enough to permit drill runners, using "Jackhamers", to drive a line of bottom or "loft" holes. Into these holes, spaced 6 inches apart, wedges from 2 feet to 8 feet long are driven—these plugs and feathers serving to free the block from the underlying ledge. In order to insure a clean break, the loft holes are driven back nearly the full width of the block. To free the key block, after it has been channeled on four sides, a charge of blasting powder is loaded and tamped on one side of the block. The firing of this small charge serves to jar the block sidewise suddenly and thus to shear it loose at the bottom almost as smoothly as if it had been channeled.

The key-block row is needful only for the primary purpose of opening up a working face across the quarry. Thereafter, dimensional blocks can be got out by drilling and broaching with the N-72's and by driving loft holes with R-12 "Jackhamers". The "Jackhamers" are also used to drill Lewis holes for lifting out key blocks and to drill lines of holes for breaking loose smaller blocks of marble. Many of the blocks weigh from 12 to 15 tons each, but still larger ones, weighing as much as 24 tons, are got out from the Mar Villa quarry.

Because of the hardness of the stone and the care taken in getting it out, the management considers that a channeler is doing well if it produces 50 square feet daily. Mr. J. C. Matthai, vice-president and general manager of the Beaver Dam Marble Company, has said: "Most marble is channeled by machine, and the average daily output of such a machine is from 60 to 110 square feet. Despite this difference, we are satisfied that our method is best under the conditions confronting us. When we started the present work, many quarrymen frankly said that we could not get out in the short time allowed us a volume of marble such as is required for the Fisher Building. Although we began work



Another corner of the quarry, where most of the drilling and broaching are done with air-driven rock drills.



General view of pit from which the Beaver Dam Marble Company gets its Mar Villa marble. The picture was made during the peak period of production when taking out marble under the first contract for the great Fisher Building. Some of the blocks of stone removed weighed as much as 24 tons each.

Source of the Mar Villa marble for the great Fisher Building in Detroit.

under that contract about November 1, 1927, still we supplied substantially 100,000 cubic feet of dimensioned blocks within the period set. We feel justly proud of the accomplishment; and we are satisfied that our choice of equipment is very largely responsible for our success."

Operations have been carried on day and night, including Sundays, with two 11-hour shifts. The force consists of 150 men—110 of them work during the day while the remaining 40 are employed at night to run certain essential machinery. No blocks are raised from the quarry after nightfall.

The quarry is equipped with four Ingersoll-Rand compressors—three being electrically driven and the fourth being run by steam. The combined output of the electrically driven units is 2,000 cubic feet of air per minute. The capacity of the steam machine is 390 cubic feet per minute. Besides operating the rock drills, compressed air serves to actuate a pump in the quarry and also to function pneumatic equipment in the associate blacksmith shop. This equipment takes care of all drill steels. and includes a No. 50 "Leyner" sharpener, a No. 25 I-R oil furnace, and an I-R pedestal grinder. Steam is supplied by a small plant on the premises; but energy for the numerous motor-driven units is purchased from The Gas & Electric Company of Baltimore. The motors have a total capacity of about 700 hp. Current for the flood lights used for night-work is obtained from the same source.

The activities at the Beaver Dam Marble Company's Mar Villa quarry give every indication of starting afresh in Maryland an industry that has an interesting historical background; and it shows what a change in architectural taste and the employment of modern equipment can bring about. The old workings just south of the Mar Villa quarry were finally closed down a few years ago, principally because of excessive cost of operation and the lack of sound, salable, dimensioned marble. The present opening contains stone of the same coloring as that previously found in the older openings, and it comes from the same stratum. Under test, Mar Villa marble has proved that it possesses the same unusual qualities which decades ago characterized the Beaver Dam marble used in the two Washington monuments and for the colonnades of the National Capitol.

Mr. W. H. Matthai is president of the Beaver Dam Marble Company, and his son, J. C. Matthai, vice-president, is immediately in charge of the quarry operations. Both of them are to be congratulated upon having so valuable a property in their keeping, and are to be commended for their alertness in seizing an opportunity and in making the most of it to the satisfaction of every one concerned. The contract for Mar Villa marble for the Fisher Building is an exceptionally large one; and it could not have been handled as it has been but for the employment of up-to-date facilities and for the decidedly skillful manner in which the quarry was organized.

The National Capitol at Washington, D. C. The beautiful fluted columns that adorn the wings of this structure are of Beaver Dam marble.

The mechanical methods now generally in use for separating lubricating oil from steam-condenser water have been improved upon, so it is claimed, by a German scientist. In the case of the Hoyer process, as it is known, a direct current is passed through the condenser water. This breaks up the milky emulsion into small foamlike flakes and makes filtration possible. About 1 kw-hr. is consumed for every 175 cubic feet of water thus purified.

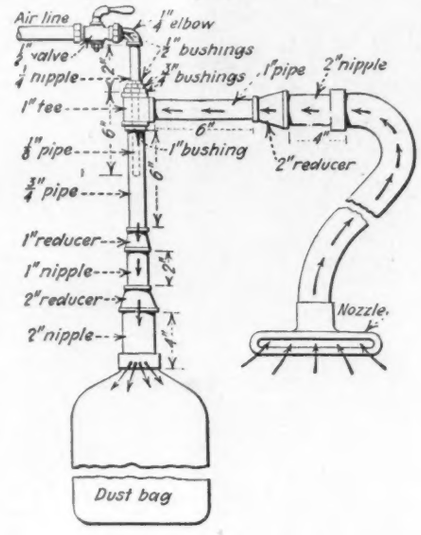
The skins of more than 1,000,000 alligators, 1,000,000 lizards, and 800,000 snakes were used in 1928 in the production of footwear and other apparel mostly for womankind. At this rate of consumption it will soon be necessary to have a closed season especially for alligators, for we are told that few of those creatures are large enough before the age of twenty to produce commercially practicable hides. In fact, the average alligator captured for his skin is closer on to 50 years old.

VACUUM CLEANER FOR INDUSTRIAL USE

UNTIL the shops of the Gary Railways, Gary, Ind., developed a sizable vacuum cleaner, the work of keeping the interiors of their cars in proper condition proved troublesome. Considering the time spent on it, and the labor involved, the results were not at all satisfactory. The ordinary household vacuum cleaner was not equal to the requirements; and from a hygienic standpoint the use of high-pressure air for blowing out the dust and dirt was not desirable. With the equipment now available, this phase of the road's car maintenance has been much simplified. Just how much so can be appreciated when it is known that it formerly took four hours just to go over the upholstered car seats, while the new suction apparatus makes it possible to clean an entire car in two hours, effecting, besides, a considerable saving in cost.

As described by the foreman of the air-brake department of the Gary Railways, the industrial vacuum cleaner operates on the principle of the injector. A partial vacuum is produced by the expansion of air under 90 pounds pressure as that air leaves a ⅛-inch pipe and enters a ¾-inch pipe, in which the smaller-diameter pipe is inserted. The air supply is controlled by a ½-inch shut-off cock; and the compressed air, drawn from the regular shop line, creates a vacuum 60 per cent greater than that induced by the familiar household apparatus. As shown in the accompanying diagram, the equipment is made up essentially of ordinary pipe nipples and fittings—the vacuum and exhaust openings consisting of 2-inch nipples turned in a lathe to receive the dust-bag and intake-hose connections.

Work on the Parthenon on the Acropolis at Athens is progressing rapidly, and its completion may be expected sometime this year. The restoration of this famous Doric temple has been going on for the past six years.



Courtesy, Electric Railway Journal.

Vacuum cleaner for industrial use operated with compressed air.

BOILERS SCALED WITH SAND BLAST

TO cut the cost of scaling locomotive boilers there has been developed at the Minneapolis & St. Louis Railroad shops a sand-blasting outfit by means of which one man in from five to eight hours' time can clean a boiler that formerly required the services of two men for at least sixteen hours. The practice is to remove either all the flues or only the small flues preparatory to scaling a boiler. In the latter case the superheater flues are also sand blasted at the same time. By the use of different lengths of piping, says the *Boiler Maker*, this equipment makes it possible to scale not only the boiler shell but likewise the water space of the fire box in between the stay bolts as well as the crown sheet in between the crown stays; and all the work is done as the boiler stands over the pit.

The outfit consists of a sand tank mounted on wheels; of three lengths of hose for air, water, and sand, respectively; and of a nozzle. The nozzle is so arranged that the admixture of air and water does not come in contact with the sand until the sand reaches the outlet pipe, which may be of any suitable length to meet requirements. This feature prevents the clogging of the nozzle with wet sand. Best results are obtained, so it is said, when the air and the water pressures are maintained at approximately 100 pounds.

NEW WAY TO CLEAN BILLBOARDS

A San Francisco concern has built an outfit for cleaning billboards by the application of steam, hot water, and liquid soap that is a great improvement over the hand method in common use. The equipment is mounted on a motor truck, and consists of a gasoline-fired boiler and of three tanks carrying water, liquid soap, and compressed air, respectively. The air is used to feed the fuel to the burner; and the tank is charged each morning from any convenient source of supply. The amount carried is sufficient to operate the plant for a full working day.

The cleaning is done by means of a fiber brush to which are attached three separate lengths of hose terminating in three valves on a manifold which is connected by a corresponding number of hose lines to the steam boiler, to the hot-water tank, and to the tank filled with soap. The manifold is fastened to a belt worn by the workman; and this enables him to move the brush freely over the surface to be cleaned and, at the same time, to control the valves as desired.

The procedure is about as follows: First steam and liquid soap are fed in steady streams to the brush which the operator rubs over the billboard. Next, he shuts off the soap supply and turns the valve that feeds hot water into the system, continuing to rub the surface the while. In this way billboards are quickly cleaned and prepared for new posters. It is claimed that by this combined treatment two men can do in two hours the work that it formerly took them three hours to do.

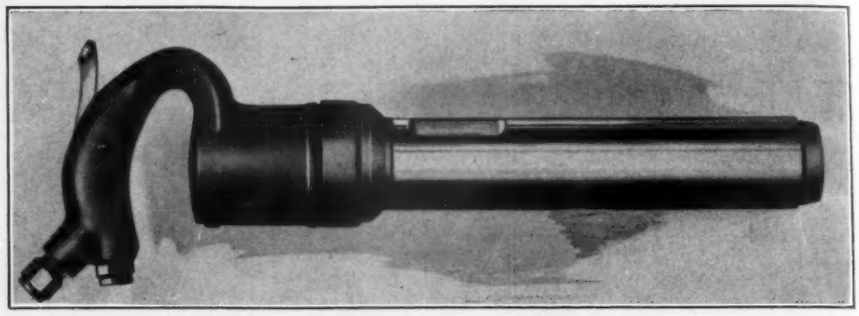
Left—Fuel for the boiler of this billboard cleaner is forced to the burners by means of compressed air. Right—The cleaning is done with brushes through which hot water and liquid soap are discharged.

SHIPPING DAIRY PRODUCTS IN VACUUM

WITH the shipment not long ago from New Zealand of some 300 large cheeses done up in vacuum containers, there was initiated the commercial testing of this new method of packing dairy products for export. The system, which was developed in Europe, has been investigated by New Zealand scientists who, our Vice Consul at Wellington reports, have accepted the findings of the European experimenters in regard to butter packing but are making independent studies of the container in transporting cheese.

The vacuum container consists of two pieces of metal stamped so as to conform as nearly as possible to the shape and to the size of the standard 80-pound cheese produced for export. After these pieces have been fitted around the cheese, the contact edges are carefully soldered with a circumferential wire buried in the solder strip, one end of the wire protruding. Mechanical exhaustion of the chamber thus formed and sealing of the exhaust portal complete the package. To open the container, the wire end is pulled outward and around the container, the wire cutting the solder band and permitting the two halves of the container to be separated. The machine used for exhaustion and sealing has been developed in the Taranaki Dairy Products Laboratory.

It is claimed that a cheese packed in vacuum for fourteen months lost only 1 pound in weight; had no rind; retained its original moist condition; and was cured as well as a control cheese packed in the ordinary crate. Physical tests revealed that after three months the original vacuum had been replaced by an atmosphere composed chiefly of carbon dioxide generated by the cheese, and that the moisture near the surface had been forced to the outside, carrying with it a certain amount of fat. Plug tests after six months showed that the cheese was quite moist throughout, with no variation in color, taste, ripeness, or other sale quality.



This new Ingersoll-Rand riveting hammer is equipped with a self-tightening handle, among other desirable features.

NEW TYPE OF PNEUMATIC RIVETING HAMMER

A NEW line of air-driven riveting hammers has been produced by the Ingersoll-Rand Company possessing marked advantages, so it is said, in a number of directions over older types—advantages which are the result of certain improvements in design.

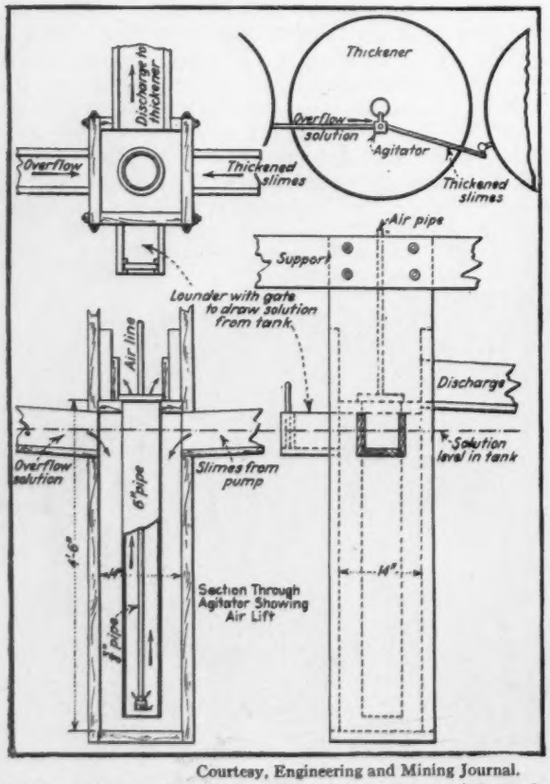
An important feature, according to the manufacturer, is the manner in which the handle is fastened to the barrel and kept tightly in place by a spring locking device. The handle is threaded on to the barrel; and the spring lock not only prevents the handle from unscrewing but also applies tension that automatically serves to tighten it. To suit all possible requirements, three different types of handles are available to choose from: an open, outside-trigger handle; a closed, inside-trigger handle; and an inverted handle—the open type being the standard.

Other improvements in design are in connection with the valve and the valve box. The valve is exceptionally strong and durable, having large bearing surfaces free from holes or ports that are fruitful sources of cracks or checks. It is housed in a hardened and ground valve box located at the head of the barrel and clamped in position by the handle. The valve box has a solid upper end, and this provides a positive compression chamber or air cushion for the piston on its up stroke. As this air cushion is not dependent upon an airtight joint between the handle and the barrel, it always acts to prevent the piston from striking the handle end. In brief, the construction is markedly rugged, making for a powerful drive on low air consumption.

The new I-R riveting hammers are known as 5A, 6A, 8A, and 9A, and are of 5-, 6-, 8-, and 9-inch stroke, respectively. They range in weight from 19½ to 25 pounds—the smallest driving hot rivets up to ¾ inch in size and the largest up to 1¼ inches.

AIR LIFT SERVES AS MIXING PLANT

UNDER the heading of *Useful Operating Ideas*, the *Engineering and Mining Journal* recently published the following interesting description of an air-lift system in use at the plant of the Wright-Hargreaves Mines, Ltd., Kirkland Lake, Ont. The system is in service in the company's counter-current decantation plant, where it was found desirable a while back to devise some means whereby it would be possible to effect an intimate mixture of the slime with the wash. This has been brought about by placing a short air lift within the central baffled zone of some of the Dorr thickeners—the incoming thickened slime and the wash solution being delivered to the air lift and there thoroughly mixed. The accompanying sketch shows the construction details of the air-lift system and its relation to the thickener.



Courtesy, Engineering and Mining Journal.

Main features of air lift used in mixing slime with wash.

The building of Saluda Dam, in the State of South Carolina, is by far the largest project now underway in the Southeastern States, says the *Earth Mover*. Considered as a construction feat only, it is staggering in its immensity. The dam will be 208 feet high, 1½ miles long, and ¼ mile across at the river bottom. This enormous fill will contain 11,000,000 cubic yards of material; and it will be built at an expenditure of $7,000,000. Back of the dam will be impounded a body of water 35 miles long and 14 miles at its widest point, with an average width of 2 miles. This huge lake will have more than 500 miles of shore line; will cover 50,000 acres; and will contain 100,000,000,000 cubic feet of water.

A new steamship service is soon to be inaugurated between Havana and New Orleans that will make it possible to transport fruit from Cuba direct to any point in the United States in refrigerator cars. For this service there are now being built for the Overseas Railway Company a special ship, capable of accommodating 95 refrigerator cars, and two powerful cranes of a new design that will be able to handle the laden cars at either port.

Looking Into the Oil-Industry's Future

What is Being Done Through the Use of Modern Methods to Provide an Ample Supply for Years to Come

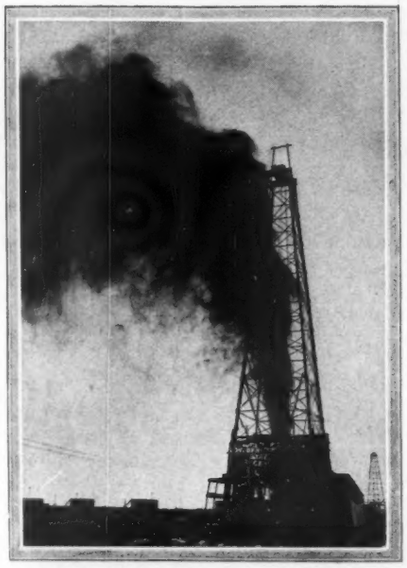
By R. L. DUDLEY*

IS there any real likelihood that, within the next few years, our oil supply will play out or become so scarce that industries depending upon it will suffer therefrom? This is a question that is put to the oil industry frequently, and one that is ofttimes answered so indefinitely that the questioner goes away feeling in his own mind that he has had no answer at all.

To quote from the highest authority within the oil industry, itself: "Oil is hidden—the industry is essentially a 'finding' industry, attended with great uncertainties in the search. The future supply of crude oil cannot be blocked out and drawn upon as needed, as in the case of oil shales, coal, and lignites, from which liquid fuel can be extracted, and of many other minerals. Favorable looking lands become oil fields when the drill has revealed the presence of oil, and only then. Hence predictions of future supply of crude oil are necessarily conjectural."

The reason why the average oilman hesitates to attempt to give a definite answer is that today no one knows where oil will be discovered tomorrow; and, too, what constitutes a reasonable interpretation of "the next few years" frequently means the difference between a definite statement and an indefinite one. Therefore, before attempting to answer the question which was put to me by the editor of *Compressed Air Magazine*, I should like to see to it that my feet are "kept on the ground" by fixing a time limit.

*Publisher, The Oil Weekly.



Landreth State No. 2, of the Landreth Production Corporation, Crane County, Texas, going over the top and yielding 6,000 barrels daily.

Not so long ago the Oil Conservation Board, appointed by the President of the United States, asked the oil industry for a report on American oil reserves. The problem was passed on to the American Petroleum Institute, as spokesman for the oil industry, and the institute put it up to executives of large oil companies who, in turn, referred it to their technical men. The final answer to the Oil Conservation Board's question came in the form of statistics, later bound in book form, which took as the basis of their reasoning a period of 25 years, with an additional 25 years "of more speculative character". The report dealt not only with the possible and probable oil supply but, equally as important, with a probable future demand; and it conveyed the definite opinion of leaders in the oil industry—which has a present-day valuation of more than $11,000,000,000—that we face no oil famine, and that for 50 years and more the oil industry can and will take care of all needs thrust upon it.

At the time of the presentation of this American Petroleum Institute report the newspapers of the country received it somewhat with misgivings, for it did not say definitely enough that in such and such a section-township-range, of such and such a county of such and such a state, a given amount of oil would be produced during the period specified. The report emphasized the feeling of the industry that new fields would be discovered and more oil taken from sands; but fault was found because it didn't state whose farm it would be found on! Of course the scientific men in the oil industry gave more or less scientific reasons for some of their conclusions, but some of those reasons did not seem to appeal to the experts of the press.

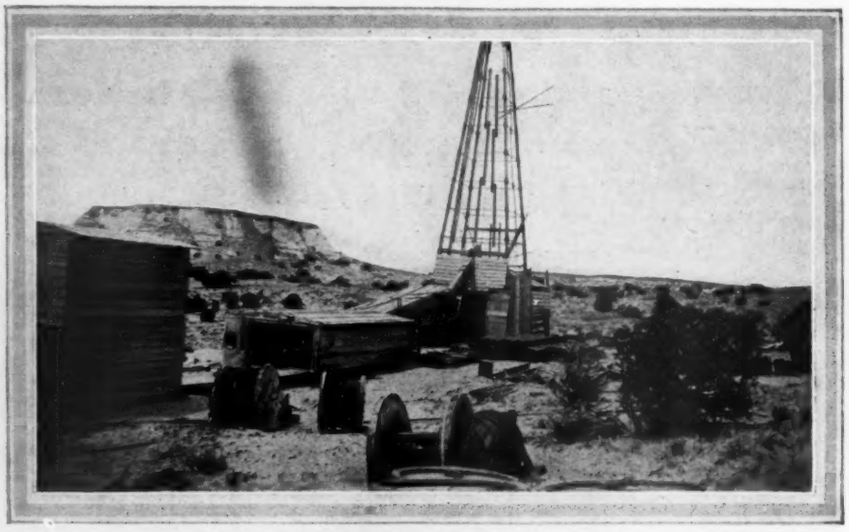
It is my purpose to give the background for the feeling on the part of the oil industry that the people in the industry will not fall down

Photo, Underwood & Underwood.

Spindle Top at night during a rush to bring in more oil. A month before this picture was taken there was but one derrick in the district. This oil field in Jefferson County, Texas, was "brought back" after being considered dead for years.

in their obligation to the public to supply its needed oil. There will be no technical details to bore you; and I hope I shall not be called to account for dealing in round numbers and approximate periods of time—it is the picture of the industry I would paint, not the detail of the nails in a wooden derrick.

To start with, we have to date, since 1859, taken from the ground in the United States, roughly, about 12,000,000,000 barrels of oil, the production for the past three years running something like 2,250,000,000 barrels of crude in the United States alone.



Phillips-Delmar Schick No. 1, drilling in Wayne County, Utah, was spudded last April after nearly a year of research and preparation. This well is 58 miles from the nearest town.

In 1925 the American Petroleum Institute estimated reserves of considerably more than 5,000,000,000 barrels from fields and wells already producing; and probably from 2,000,000,000 to 3,000,000,000 barrels additional reserves have been uncovered since that time! In 1908, Day made an estimate giving a minimum and a maximum quantity of oil remaining underground of from 8,015,000,000 to 22,515,000,000 in round numbers, respectively. For error he allowed a latitude of 280 per cent! Arnold made an estimate in 1914 of 5,700,000,000 barrels, while the United States Geological Survey estimated 7,600,000,000 barrels plus 75,000,000 barrels "prospective" in 1915, and 6,700,000,000 barrels in 1918. Since the 1908 estimate by Day, about 9,000,000,000 barrels have actually been produced!

It can be said with truth that because a hurricane strikes a certain section one year there is no reason to expect it to strike the same place the following year. And, *per se*, the fact that new oil fields are being brought in is no reason to say that we shall continue to bring them in. But let us look at the records of the oil industry during the past fifteen or twenty years, and hurry with this picture, which I hope will show why the men in the oil industry are optimistic.

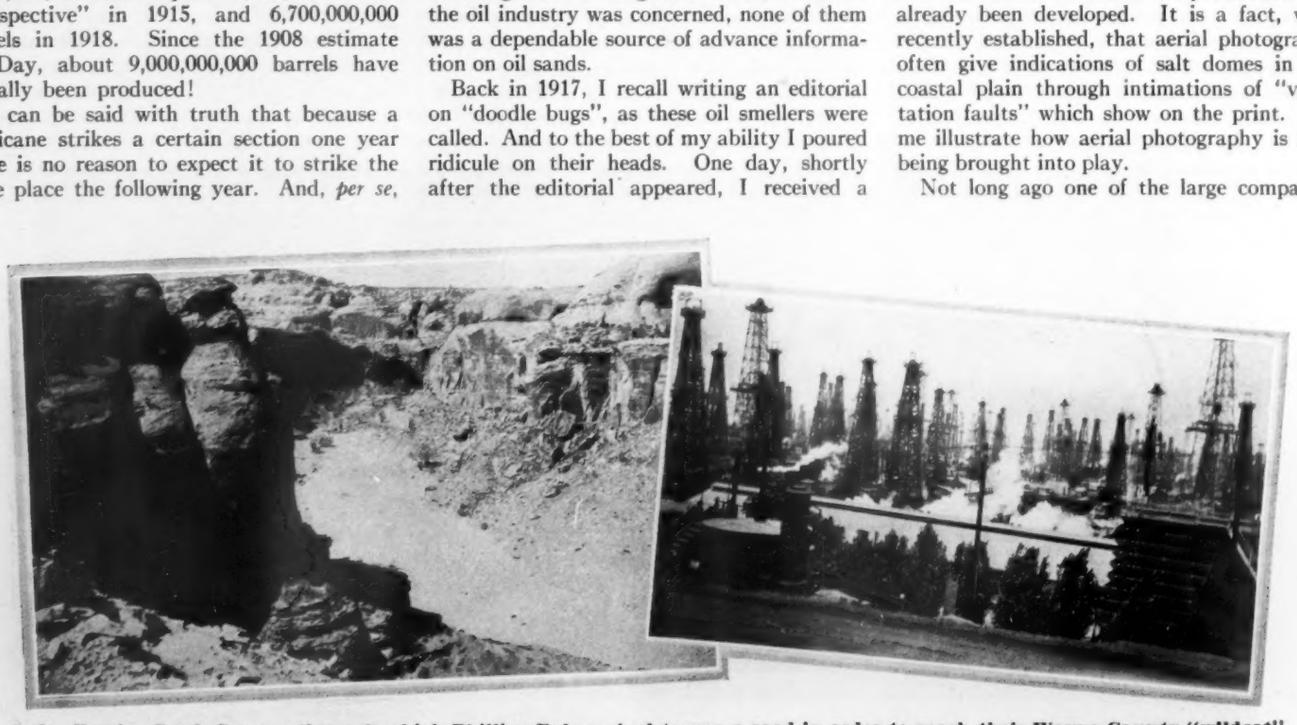
Fourteen years ago there were men in almost every oil-producing section who manipulated witch-hazel twigs or electrical devices using no electricity, or who dreamed dreams to assist the oilman in locating oil beneath the surface. Some of them were desperately serious about it, some—well, some of them had to do something to keep the police from arresting them as vagrants! But, as far as the oil industry was concerned, none of them was a dependable source of advance information on oil sands.

Back in 1917, I recall writing an editorial on "doodle bugs", as these oil smellers were called. And to the best of my ability I poured ridicule on their heads. One day, shortly after the editorial appeared, I received a clipping from a German publication describing the Eotvos torsion balance, which was being used in locating certain subsurface formations in Germany, and attached to the clipping was the notation: "Maybe there is something to some doodle bugs, after all."

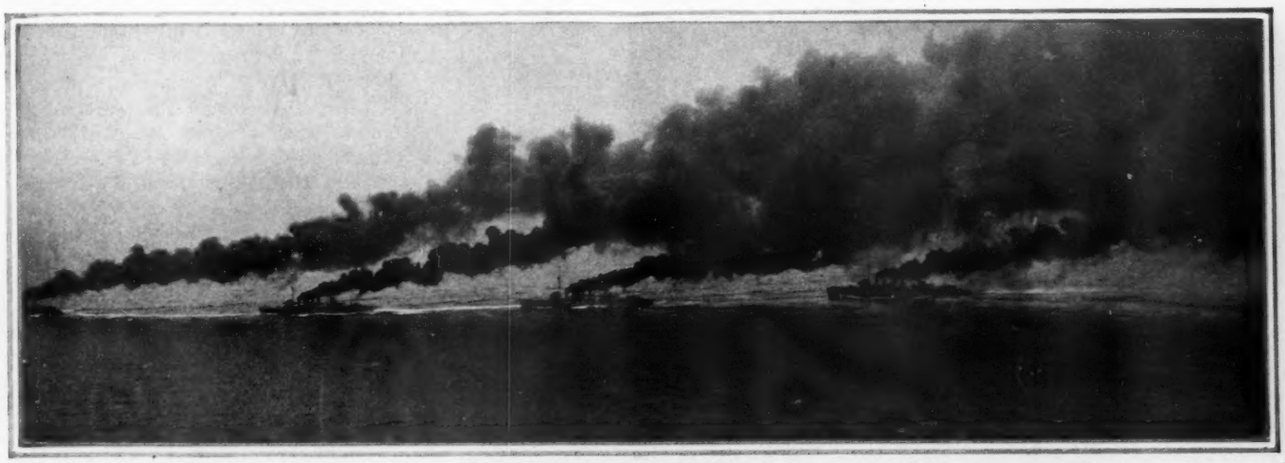
What has happened in the oil country during those fourteen intervening years? Today, the torsion balance, the seismograph, and the magnetometer are commonly accepted instruments employed to locate salt domes, around which oil generally occurs along the Gulf Coast plains of Texas and Louisiana. And what has been the effect?

Fourteen years ago there were about thirteen producing fields in south Texas and Louisiana and four or five known salt domes around which oil had not then been discovered. At that time the finding of oil or of a salt dome in the coastal country was the signal for a wild rush, reminiscent of the gold days. Since geophysical methods have come into everyday use, new salt domes are located monthly. On one occasion, during a period of slightly over twelve months, 27 new domes were discovered by geophysical methods—subsequent drilling having proved, with salt cores, the actual presence of salt domes, while in a number of instances oil production has already been developed. It is a fact, very recently established, that aerial photographs often give indications of salt domes in the coastal plain through intimations of "vegetation faults" which show on the print. Let me illustrate how aerial photography is now being brought into play.

Not long ago one of the large companies



Left—Barrier Creek Canyon through which Phillips-Delmar had to run a road in order to reach their Wayne County "wildcat". The road is dimly visible in the center of the 850-foot canyon. Right—Section of a new deep-sand development, Long Beach, Calif.



Destroyers throwing out a smoke screen to hide the main squadron from an enemy. Such screens are produced by burning temporarily an excess of fuel oil.

operating in Texas and Louisiana found indications of a salt dome while using the seismograph in a Louisiana swamp. The field marks locating this probable dome were fixed, but high rains and a consequent flood destroyed them. So when the seismograph crew went back to relocate the lost dome they couldn't determine where to start their work.

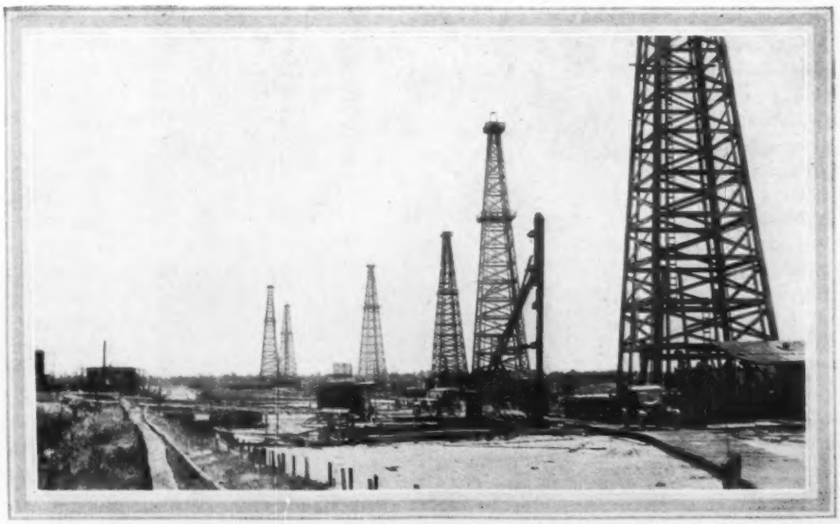
Later, an aerial photographer was called into service, and he mapped the entire swamp. If you have ever been in a Louisiana swamp you will realize that he had a real job. At an elevation of 1,000 feet the prints showed nothing. However, pictures taken at a height above 5,000 feet indicated a break in the vegetation, etc., running in somewhat of a circle about an inch in diameter on a print which embraced several square miles. With the aid of the definite markings on the photograph, the seismograph crew were able to find the lost dome!

All of this is mentioned to show what is being done in one part of the country to locate oil. Right now many areas, originally condemned by geophysical methods, are being reworked because geophysical science is only in its infancy in so far as the oil industry is concerned, and new knowledge as it is brought forth is being used to better and better advantage. I give these instances in a territory which is my hunting and playing ground because I am familiar with them and because the gradual development of the territory has been almost as much a part of my life as the daily news and happenings recorded in our morning papers here.

Applications of these methods of finding favorable indications of oil—thus far no machine has been developed which will actually find oil—will doubtless be made successfully in other sections of America and in foreign oil countries. What they have in store for the world of course no one knows, but if we may judge by what they have added to oil information in the past they may be depended upon to contribute data on oil-bearing formations that we little dream of now. And while geophysical science has been assisting in the location of oil, the application of geological knowledge has not lagged. What geology has done for the oil business may be summarized from the following observations which cover a period of but fourteen years.

Fourteen years ago Pennsylvania and other eastern states were recorded as history in the oil business. In the country west of the Mississippi certain sections were under development, while others were marked in the oilman's mind as unattractive territory for oil development. Southern Oklahoma, fourteen years ago, was a babe in so far as oil was concerned. Kansas had a small production. In Texas, the oil from the Gulf Coast, Electra, and a small field at Burkburnett, together with some very shallow production at Corsicana, constituted almost the sum total of commercial output in the Lone Star State. Wyoming had only a few oil wells. Other mountain states had seen none. California had experienced some big developments, although the Los Angeles basin, as an oil empire within itself, was yet to affect the world crude market. Here is what has happened within the brief space of fourteen years, and in it oilmen see a promise for the future.

That great section from Mexia up to Corsicana had been thrown into the discard by most oil companies. And yet, the first year it "came in"—in 1921—it produced nearly 5,000,000 barrels, only to increase to 35,000,000 the following twelvemonth. From 1921 up to the first of this year this East Central Texas District had produced 218,000,000 barrels of oil—indicating what a joker had been thrown into the discard! It was two years after the "fault country", East Central Texas, was opened up that the Los Angeles basin, with its deep sands at Signal Hill, Long Beach, and Santa Fe Springs, contributed a veritable flood of oil—which flood continues.



Oil wells now skirt Sulphur Dome, Sulphur, La., and once more lend a businesslike atmosphere to the field which has the distinction of being the first sulphur-producing area of the United States.

Within fourteen years the oil industry has seen another great area—more fitted for the coyote and the prairie dog than anything else, it was said at the time—develop into a Ranger oil field, a Breckenridge, and scores of smaller pools. And even in 1918-19, when Ranger and Breckenridge came in producing oil, that territory lying farther west and also the Texas Panhandle were discounted by the majority in the oil industry. Yet, today, the oil business is suffering acutely because the country just mentioned, Winkler County,

Yates, etc., is flooding the market with oil. Such wells as the Yates pool, in Pecos County, Texas, has produced and still is producing had never before been seen in the United States at such shallow depths. And yet a venturesome "lease hound" had some of this very land under lease and companies now operating there turned it down ten years ago.

Now I make my living from the oil industry and I wouldn't have you think that oilmen passed up these prospects ten years ago because they were some particular type of d—fool. What I would make clear is that in the light of knowledge gained during a decade, a knowledge that has not come accidentally but which has been gained in deadly earnest, territory long ago thought to be worthless is today producing oil!

To go on with my history, the oil industry has seen large fields opened up in southwest Texas; and a new development is bearing fruit right now in east Texas. In west Texas new pools have been opened so rapidly during the past two or three years that the man is rare who is well enough acquainted with the business to tell you a third or a fourth of them without referring to records. It is within a very few months that a new field was opened in Mississippi, east of the Mississippi River. This development is a tribute to geophysical methods.

Leaving Texas and Louisiana, we have seen Arkansas step into the oil-production column, another tribute to geological study. Southern Oklahoma has grown to the point where, less than two years ago, Seminole, coupled with advanced methods of getting a larger recovery of oil, broke the oil market and cost the industry probably half a billion dollars! "Seventy-five miles of derricks", so it was described a year and a half back, in a district where no oil had been thought possible ten years before! Fourteen years ago a few people had heard that some water wells at Artesia, New Mexico, had a peculiar smell and taste. Today New Mexico is producing oil, and her possibilities—what can we say of them? Certainly, they look better today than Pecos and Winkler counties looked ten years ago.

Only a portion of what has happened in the discovery of new fields has been recorded in the foregoing paragraphs. To record them all would be to write a book. What has happened abroad in this period? Is it not reasonable to suggest—in view of the slight development there has been in many new producing countries—that when they have experienced the intensive study and development that the United States has in this direction, we may see a repetition of what has happened at home? But let us see what really has happened abroad, even with the slight work that has been done.

In fourteen years Venezuela has become a factor—a most potent factor—with her more than 50,000,000 barrels per year exported. Columbia is another,

The Texon Oil & Land Company's University B-2 is the world's deepest productive well. This test well has already reached a depth of 8,520 feet and may be carried to a still lower level.

Persia still a third producer to be reckoned with. And within the year, the newly created Turkish Petroleum Company completed a 96,000-barrel wildcat well in Mosul, Mesopotamia! Oilmen in America are far more afraid that Mesopotamia will affect the American oil-producing business than that our supply here will dwindle to nonprofitable proportions.

While the geologist and the geophysicist, assisted by the American driller and backed by American capital, have been opening new fields at home and abroad, the brother of the geologist and the geophysicist, the petroleum engineer, has been just as busy getting more oil from a given sand and making it possible to drill to greater depths than the imagination of the average oilman conceived fourteen years ago.

A gusher in Baku, Russia, one of the world's foremost oil fields.

I can almost count the years back on my fingers when a 3,500-foot oil well was considered a very deep hole in the section of the country where I live. A friend of mine actually got oil at a depth of about 4,500 feet in two wells in 1918; and when they sanded up, and he lost them after a flow of a day or two, other friends sympathized with, "You really can't expect to handle oil at that depth in this country, anyway." Yet, today, there are, in that very field, wells 1,000 feet deeper than his two poor wells, and production is being accomplished fairly economically. In California oil is being successfully produced at a depth of more than a mile and a half! And a 5,000-foot hole is not talked of with the same bated breath as was a 3,500-foot hole fourteen years ago. What is the answer? Engineering skill is making it possible to go to greater depths and to uncover oil sands which were inaccessible a decade back.

The American Petroleum Institute report previously referred to, dated 1925, suggested the possibility of oil in deeper sands in a number of sections. One was at Long Beach, Calif., already a deep-sand field. That sand, lying 6,000 to 7,500 feet below the surface, is being developed and is hanging as a threat against the oil market for early 1929! Here are some others suggested in that report as having deeper sand possibilities: Salt Creek, Gulf Coast, Colorado, other known fields in California including a probable deep sand under the City of Los Angeles, itself, which cannot now be drilled because of a city ordinance, Cat Creek field in Montana, most of Texas, much of Oklahoma, Kentucky, and even some prospects in Pennsylvania and other states called the birthplace of the oil industry!

How far can the drill go and get oil? A friend of mine, a geologist in whom the industry has great confidence, in answering this question for me a few years ago, said that oil would be found at greater depths than the operator could handle it. He figured that at around 10,000 feet—at which depth he indicated a belief that certain prolific production might be found—the drilling bit would become so hot that it would not perform. Yet they are drilling for steam in California; and in drilling those wells the bit endures a degree of heat that causes ordinary tool steel to glow a dull red! I am not joking either about the steam wells or the heat of the steel!

From how deep a source can oil be produced if it is there? Ask the engineer who developed machinery to drill from 3,500 to 5,000 feet, then to 6,500, and now to more than 8,000 feet; and ask his right-hand man, the driller, who, armed with better machinery, is seeking lower depths each day. Though neither a prophet, nor a relation of one, I can see ahead wells successfully handled at 10,000 feet, and my imagination is not greatly strained thereby. What will

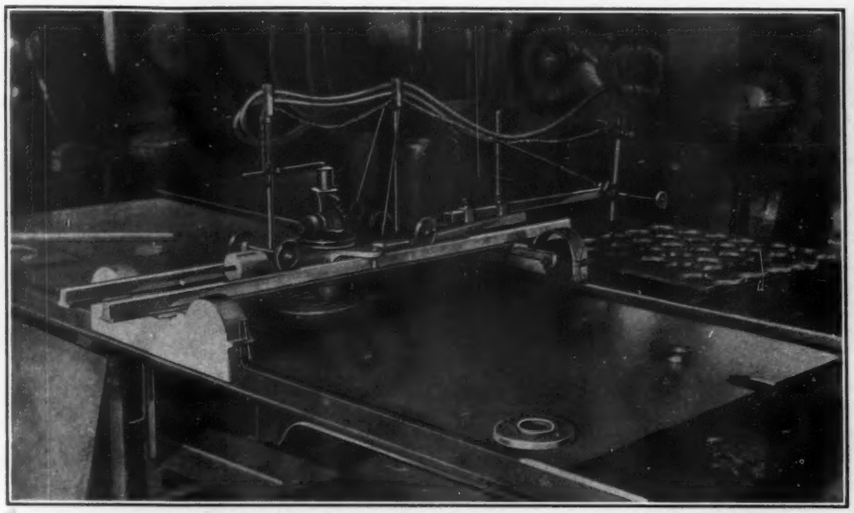
these new depths open? In many sections, due to the underlying formations as we now know them, nothing: in many other sections probabilities of oil that will care for our needs for years to come.

Still other factors enter into an assurance of an oil supply. Today more oil is being taken from a sand or rock of given porosity than ever before, thanks to the engineer, whether he carry the degree of college or the mud-stained diploma of the man who "kin remember when". Repressuring of oil sands through the pumping of air or gas into them, and a consequent gain in production of the wells around the "intake well", is not a guess but an accomplished fact. The use of air and gas lifts, in which the science of compression is called into play with astonishingly favorable results, is now a part of the oil-producer's code. Flooding of oil sands to increase recovery is successful in some sections. Oil mining to get the residue after wells quit producing is a big possibility of the future. It is being done in France and Germany now. Better methods of handling the oil after it comes from the well have resulted in less waste and a gain to the consumer. Then there are the billions of barrels of oil in shale deposits, estimated at 108,000,000,000, to be more exact.

And finally, while the producer and the scientists working with him have been busy, the refiner who turns the oil into gasoline and lubricating oils has been equally active. Through pressure distillation he has steadily augmented the yield of gasoline from a barrel of crude oil. It is certainly well within the realm of reason that the average yield of gasoline per barrel of crude can be increased by a very wide margin as the need for it makes it worth while. There is no occasion to reduce it to columns of figures, but, when the time comes, it will be possible, undoubtedly, to take at least 25 to 30 per cent more gasoline from the average barrel of oil than it now yields in the refineries of the United States and abroad. And, speaking from the standpoint of the user, H. L. Horning, president of the Society of Automotive Engineers, said in 1923: "It is possible to double the miles per gallon of gasoline for cars and trucks. When the public want it, they can go 40 miles per gallon with small cars."

The "demand" committee of the American Petroleum Institute, in figuring the future demand for gasoline, estimates, and gives reasons for doing so, "that if improvements in refinery and automotive engines are adopted as foreshadowed, a petroleum supply would be required of less than 500,000,000 barrels in 1950, as compared with 643,966,000 barrels actually run to stills in 1924."

No, I am not greatly concerned about oil playing out within 50 or more years, and I hope that I have been able to give you, from a maze of figures and from rambling incidents in the oil business, a conception of the factors which sometimes lend a lurid tint to the oil-man's answer to the question, "Do you think we will run out of oil soon?"



Cutting a steel plate into disks of uniform size by the automatic oxy-acetylene machine. This shape-cutter is capable of handling metal up to 1 foot and more in thickness.

OXY-ACETYLENE MACHINE CUTS METAL TO SHAPE

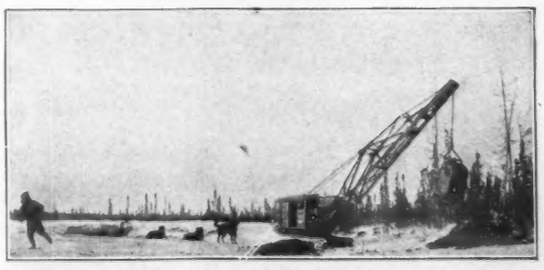
AN automatic oxy-acetylene machine designed to cut steel plates and sheets, forgings, billets, or ingots into all sorts of shapes has been introduced by The Linde Air Products Company, of New York City. In this machine, the cutting blowpipe is so mounted on a carriage that it can be moved in any direction by means of an electric motor.

In the case of repetitive work, the blowpipe is guided automatically by templates; but when only a few parts of a kind are to be produced, then a tracing device, directed by hand, is made to follow the lines of a sketch or blueprint. With this machine it is possible, so it is claimed, to make accurate and smooth cuts in stock up to 1 foot and more thick and at a speed of from 3 to 20 inches per minute, depending on the thickness. Only one man is needed to attend to the machine, which is capable of effecting substantial savings in labor, time, and material.

POWER EXCAVATORS AT WORK NEAR ARCTIC CIRCLE

IT has been estimated that $1,750,000 will have to be spent in excavating for the new rail line now being run by the Canadian National Railway for a distance of 156 miles from railhead northeast of Le Pas to Fort Churchill, on Hudson Bay, not far south of the Arctic Circle. This sounds like a large sum of money for grading only, but is explained by the fact that frozen ground may be encountered there 18 inches below the surface even in midsummer. It can therefore be appreciated that power excavators are experiencing considerable difficulty in removing the dirt preparatory to rail laying.

It is because of these and other difficulties that the construction of this important road, the value of which has been appreciated for years, has been so long delayed. The work is now well in hand; and for many months the excavators are expected to be busy preparing the way for this stretch of the Canadian National Railway that will, when completed, shorten the rail haul between western Canada and the eastern seaboard by 1.000 miles.



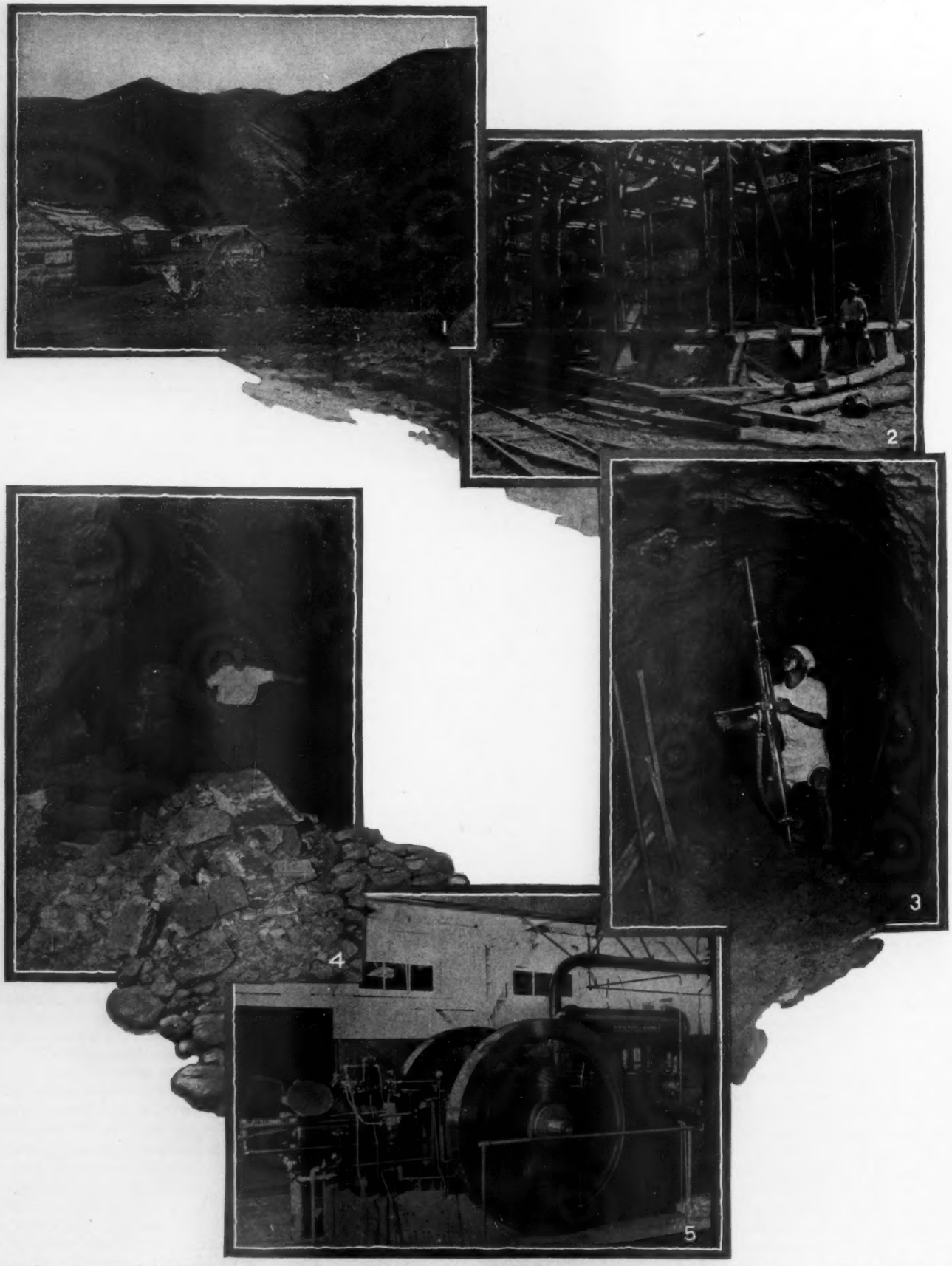
One of the two 1¼-yard P&H dragline excavators on a railroad construction job in the frozen North.

ELECTROPLATING ALUMINUM

A PROCESS for coating aluminum with films of zinc, nickel, copper, or chromium, or combinations of those metals, has been developed by Stafford O'Brien & Company, Ltd., and put to commercial use in London. The *Engineer* announces that it is an electrolytic plating process that is both practical and inexpensive.

Anodic treatment results in the formation upon the aluminum of a thin skin of oxide, which is non-conductive and non-corrosive under normal atmospheric conditions. When not carried to its full extent, the treatment prepares the surface of the aluminum for a coat of nickel, upon which, in turn, a layer of copper is deposited. If desired, and after the copper film has been polished, a coat of chromium may be deposited upon the other two—the finished article being so bright in appearance as to require no further cleaning.

It is claimed that the films are adherent and not liable to strip; and that acid and salt-spray tests have been applied with satisfactory results. Aluminum alloys may be similarly coated without difficulty when their copper content is, say, not in excess of 6 per cent, preferably 3 per cent.



1—Camp at one of the chrome mines, which may be seen in the middle distance. 2—Compressor house in course of construction. 3—Starting a raise with a CC-11 stopehamer drill. 4—Mr. Enoch Perkins, general manager of the New Caledonia chrome mines of the Mutual Chemical Company of America. View of stope, showing method of bringing up cribbed chutes through the waste fill. 5—The POC-2 unit that supplies the compressed air needed at one of the properties.

New Caledonia a Potential Mining Camp

By A. M. HOFFMANN

THE mention of the name New Caledonia at once suggests to the average person a penal colony, and yet the French Government has sent no convicts to that far-away island in the western Pacific since 1896. The criminal element is rapidly decreasing, and in 1921—the date of the last census—there were but 2,310 ex-felons among a population numbering 47,500. Under those circumstances it is only fair that New Caledonia be given its rightful place in the sun

Until 1853, New Caledonia was a sort of no man's land; but in the years that have intervened, under French rule, it has prospered. Its natives, Melanesians, have the reputation of being excellent agriculturists—in fact, are said to be superior in this respect to all the other Pacific races. The chief crops are coffee, maize, tobacco, sugar cane, potatoes, vegetables, and some cereals. Stock-raising is also being pursued; and among its exports, besides coffee, copra, and other produce, are listed preserved meats and hides. However, these commodities constitute but a small part of the colony's exports, which consist mostly of ore, such as nickel, chrome, and cobalt.

A decade after the French took possession of New Caledonia, Jules Garnier, of the French Corps of Mining Engineers, was sent by his government to study the geology and the mineral resources of the island. For three years that scientist thoroughly explored all parts of that then uncivilized country. At the end of that time he reported the presence of large deposits of copper, chrome, and, foremost, of the nickel-magnesium silicate which now bears the name of garnierite in honor of the discoverer. The list of all the minerals found by Garnier is a very formidable one, especially for an area comprising only 8,548 square miles, and includes gold, silver, lead, zinc, iron, antimony, coal, limestone, gypsum, quicksilver, graphite, tungsten, titanium, manganese, molybdenum, tin, bismuth, cadmium, barium, asbestos, talc, arsenic, and petroleum. Whether or not all these are available in commercial quantities, it must be admitted that New Caledonia is a highly mineralized area.

But it is with chrome ore that we are at present chiefly concerned, first, because one of America's leading chemical corporations has opened up two chrome mines in New Caledonia and, second, because of the increasing use to which this mineral is being put. The properties in question, known as the Fantoche and the Alpha mines, are both located on the west coast, at Nehoue and Pegoumene, respectively, and have been producing for about five years. The ore from these sources is what is designated as red chrome. It is of high grade, low in silica.

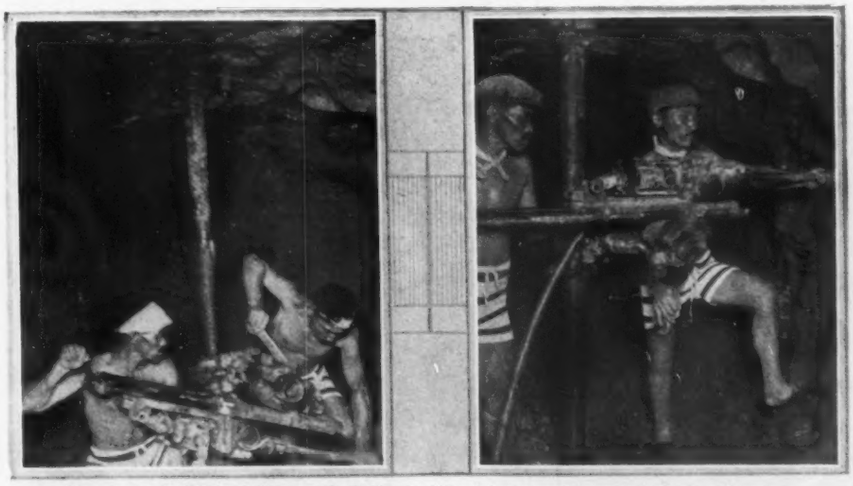
This method of double jacking has given way to the use of "Jackhamers" in one of the chrome mines operated in New Caledonia by the Mutual Chemical Company of America.

Mining is done by hand methods and by means of CC-11 stopers and DCR-23 "Jackhamers"—the air for these machines being supplied by a POC-2 compressor, that is, by an oil-engine-driven unit. The labor employed is a decided mixture of color and races, and consists of Arab and French ex-convicts, Japanese, Javanese, Tonkinese, etc. From the mines, which are situated above sea level, the ore is first conveyed by aerial carriers to a lower level, whence it is transported by rail to the near-by ports. There it is loaded into specially chartered ships for its long journey to the Atlantic seaboard—nearly two months being required to make the run of approximately 10,000 miles.

In the form of bichromates, this raw material from the antipodes is utilized, principally in tanning leather, in dyeing cloth, in the manufacture of pigments, and, to a lesser extent, in the production of other chemicals. One of its newest uses is in plating metals, that is, applying by electrolytic action a thin coating of chromium upon steel, bronze, or other kindred surfaces. Chromium plating gives such surfaces greater hardness as well as non-corrosive properties, and for that reason is now widely utilized instead of nickel-plating in the automobile industry and on bearing journals and other parts of machinery that are subject to wear. In printing, for example, a film of chromium one five-thousandth of an inch thick will make a case-hardened steel plate, of the kind used by the Government in printing our paper currency, last just about twice as long as it would without this protecting coating.

It is because of its inherent hardness that chromium, as such, is now extensively employed in making high-grade alloy steels for armor-piercing projectiles, for safe plates, for crushing machinery, and for those many other services calling for a material of great strength and toughness. As can be seen, both bichromates and chromium are playing an essential part in our industrial life; and our present-day demand for the basic product, chrome ore, is double that of about fifteen years ago.

Note—We are indebted to Mr. Enoch Perkins, general manager of the Fantoche and Alpha mines, for the photographs used to illustrate this article.



Japanese driving drifts with DCR-23 "Jackhamers" mounted on columns.

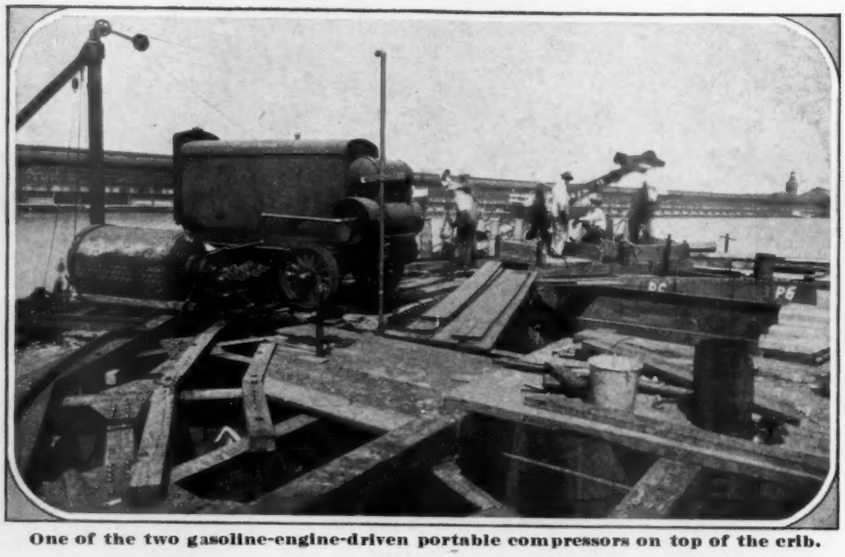
A subway-building program, covering a period of eight years and involving an outlay of $40,000,000, has been proposed by the Municipal Council of Paris to relieve traffic in certain congested areas. Besides the construction of three miles of subways, the plan includes a system of moving sidewalks underground. These sidewalks are to connect the various railroad stations of the capital, and while they are designed primarily for the convenience of pedestrians they may possibly be used at certain hours of the night for the transportation of baggage and foodstuffs consigned to the city's markets.

Two promising oil fields are reported to have been discovered in Korea in districts rich in coal deposits.

New Intake Crib for Chicago Gives Increased Water Supply

By JOHN N. THORP, JR.

CHICAGO, like all large American cities, has grown so rapidly that it has been almost impossible to maintain a supply of water commensurate with its needs. In fact, the demand for water has been greater than the increase in population would seem to have justified. In addition, certain waters drawn upon from Lake Michigan were threatened with contamination. The problem of providing an adequate and a safe supply to meet present requirements—a system that would lend itself to enlargement so as to take care of future growth—was given very serious consideration by the engineers of the Chicago Department of Public Works, Bureau of Engineering.

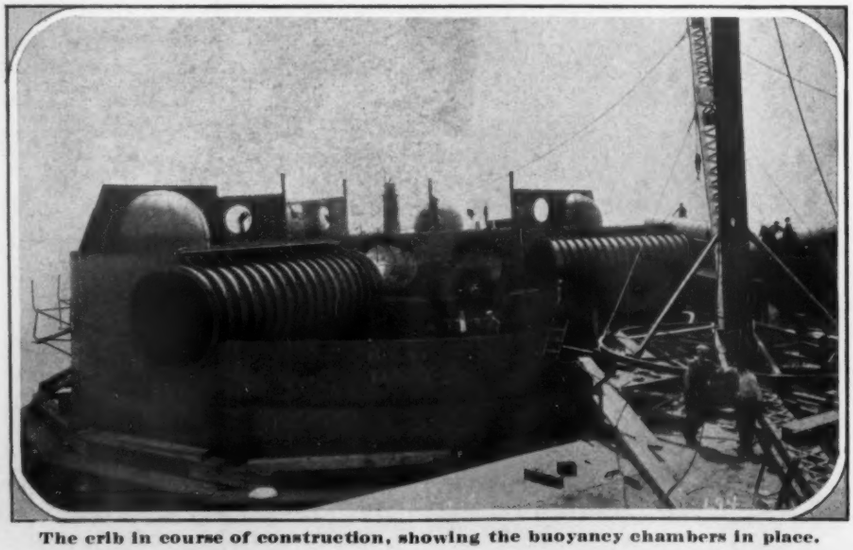


One of the two gasoline-engine-driven portable compressors on top of the crib.

Some years ago this study crystallized into a definite recommendation, namely, that a new tunnel, including a new intake crib, be constructed to serve three of the city's major pumping stations—the Chicago Avenue, Springfield Avenue, and Central Park Avenue stations. It was further recommended that the oldest of the water-intake cribs be abandoned. This intake was two miles long, and was built in 1867. The work of constructing the tunnel has been in progress now for some years. The new crib is located adjacent to the Carter H. Harrison Crib and will be operated by the same crew, thus saving the municipality an appreciable annual operating charge.

The job involved the assembling and the erecting of the steel shell of the crib; launching and floating it to a definite position in the lake; sinking it to a bearing on the lake bottom; placing about 5,500 yards of concrete fill; and building a superstructure and an intake shaft. The steel for the structure was fabricated and framed by the Chicago Bridge & Iron Company of Chicago, and was erected in the harbor at the south side of the Navy Pier in about 20 feet of water. This location was selected because it is protected from storms and is adjacent to a deep-water channel to the lake.

The foundation structure for the erection and the launching of the crib shell consisted of a platform of 64 oak piles driven in two concentric circles—the center of the circles being about 50 feet from the dock, and the radii of the circles being 47 feet 6 inches and 17 feet 6 inches, respectively. The piles were then capped in pairs, and under the caps and extending between the piles there were hung sixteen 24-inch steel I-beams. The beams were set level and horizontal with their bottom edges just above the water, making a rugged structure well tied together. The setting of the shell plates, diaphragms, 14-ton port tubes, port bulkheads, and large buoyancy chambers followed, and then the riveting commenced—the compressed air being supplied by a 600-foot Type XB-2 Ingersoll-Rand compressor.



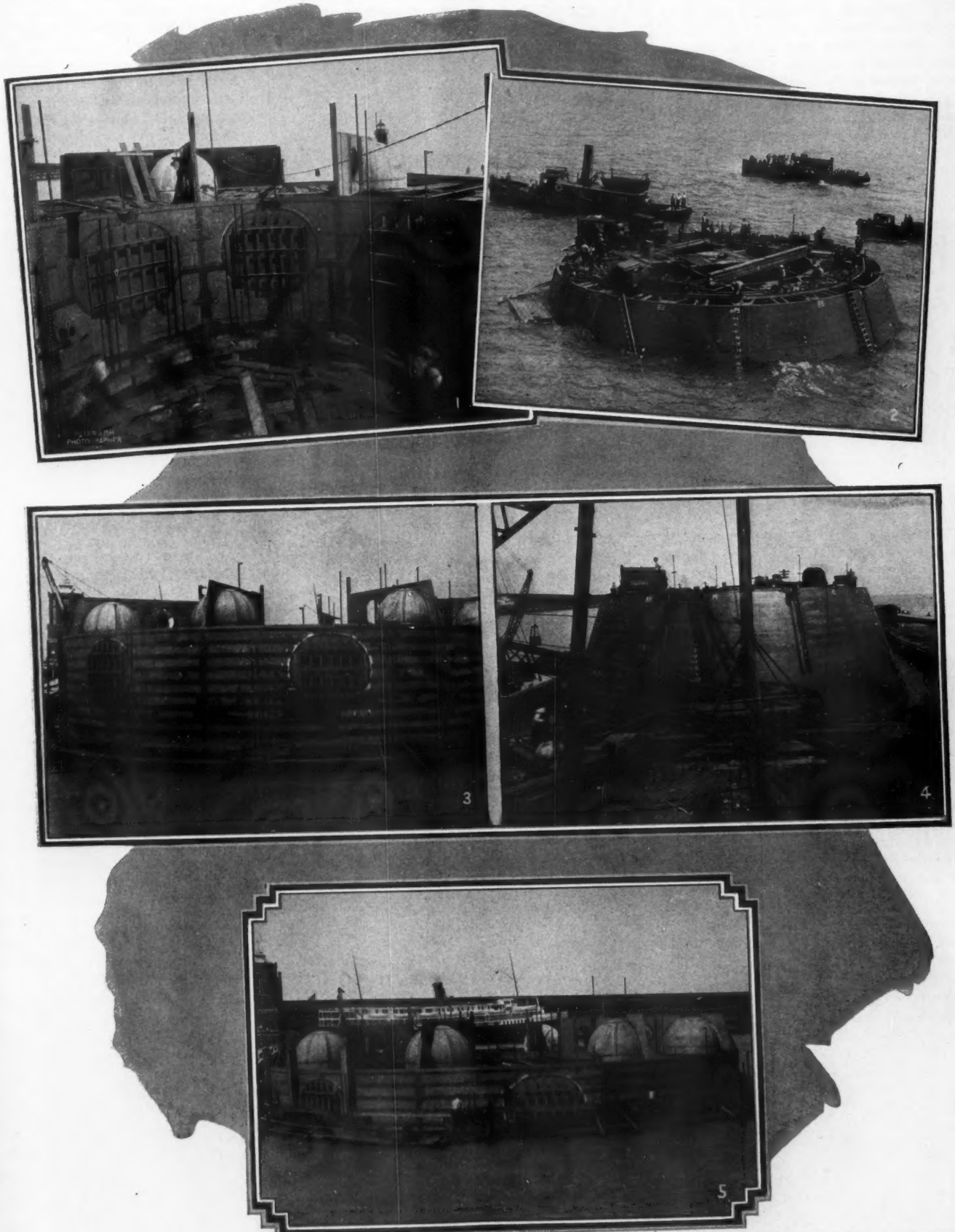
The crib in course of construction, showing the buoyancy chambers in place.

Erection was stopped after the shell plates were set to 17 feet above the cutting edges, this being the point at which the outer shell plates began to batter inward. There was in place at that stage about 450 tons of steel; and when riveting was completed the crib was ready for launching. Actual launching of the crib was accomplished by means of long, 2-inch, threaded rods with two nuts each—the crib being gradually lowered into the water by backing off the upper or supporting nuts until the structure floated by reason of its own buoyancy. With this done, the remaining steel was erected.

The port tubes, as fabricated, were watertight from end to end; and bulkheads provided for the ends of the ports made them serve as buoyancy tanks during flotation. The bulkheads were made of plates, reinforced with I-beams, and shaped to conform closely to the circular shells of the crib. There was a faceplate for each end of the ports, and this was made endless by welding and riveting it in place outside the shell plate and through the flange around the ports.

Each of the ports, buoyancy chambers, and ballast tanks was equipped with sea valves so that the chambers could be flooded when the crib reached its final location in the lake. Provision was made for unwatering the ports and the buoyancy chambers, in case of leakage after flotation, by pipe connections through which compressed air could be forced. Two 9x8-inch Type 20 portable compressors were placed on the crib for this purpose and used for the completion of the crib.

On July 25, 1928, the crib, drawing 20.5 feet of water, was towed to its proposed site by two tugs without difficulty, and sunk by opening the



1—Well room of the new intake crib at the time of launching. 2—Crib nearing completion. The two portable compressors aboard supplied air for unwatering the ports and the buoyancy chambers to keep the structure afloat during the final stages of its construction. 3—Bottom section of the crib just before launching and with the lowering screws in position. 4—Crib alongside the Navy Pier, looking east from the top of the tool shed. 5—How the structure appeared immediately after launching.

sea valves to the buoyancy chambers. The construction of the shaft through the bottom of the crib to the intake tunnel, 190 feet below the surface of the lake, is now in progress. The work is being carried on by the Department of Public Works of the City of Chicago under the direction of Mayor William Hale Thompson; Richard W. Wolfe, commissioner; Edward F. Moore, deputy commissioner; Loran D. Gayton, city engineer; Orville Carlisle, engineer water-works design; James J. Verslius, engineer water-works construction; and A. G. Anderson, assistant engineer who is in charge of the actual operation.

FLEXIBLE FLOW METER

A NEW type of indicating flow meter has been produced by the Meriam Company, Cleveland, Ohio, that is suitable for measuring the flow of air, gas, saturated or superheated steam, and oils or other liquids at any temperature or pressure. While primarily designed for high line pressures—1,000 pounds per square inch or more, they may be used with slight modifications for registering vacuum or low pressures.

The operation of the instrument is based upon the principle that the flow of a liquid or a gas causes a loss in pressure along the pipe. To insure correct readings, an accurately proportioned orifice disk is placed inside the pipe and in the path of the flow, and two small tubes are connected to the pipe line, one on each side of the orifice disk. The difference in pressure exerted against the two sides is recorded by a mercury level or one employing some other non-evaporating liquid of constant weight. As there are no springs, gears, etc., to get out of order, the indicator is said to give precise readings over long periods. The orifice disk is made of Monel metal, and will therefore not corrode. The scale may be calibrated in cubic feet, pounds, gallons, barrels, or other quantities delivered per hour, to suit individual needs.

An entirely new material has been produced in Germany, reports *Domestic Commerce*, that lends itself to a variety of uses to which paper, cardboard, and leather are generally put. While its composition has not been made public, the top surface of the material has the appearance of metal while the underside looks like paper. It comes in different colors; can be bent or folded without cracking; does not tarnish; and may be embossed or printed upon by the ordinary methods.

Two of the three CC-35 paving breakers that greatly facilitated the rescue work. Their timely use helped to save life and to uncover quickly many of the bodies buried beneath the collapsed structure.

PNEUMATIC EQUIPMENT TO THE RESCUE

TO a portable compressor and three paving breakers must go much of the credit for the few lives that were saved following the collapse of a concrete apartment house in course of construction in a populous section of Prague, in Czecho-Slovakia. Six floors of the 7-story structure were standing when, without the slightest forewarning, it crumpled and crashed to the ground with a roaring explosionlike noise that frightened the citizenry for blocks around. Seventy men were at work in the building at the time, but none of them was able to escape; and a policeman, on duty near by, estimated that at least twenty pedestrians also had been caught unawares and buried beneath the wreckage.

Immediately after the catastrophe, the entire municipal fire department and some squads of soldiers and police were rushed to the scene of the accident. These, however, were not able to make much headway in removing the debris, as the pickaxes used for the purpose made little impression on the large pieces of concrete that had to be shattered before they could be cleared away. But for the prompt action of the local agency of the Ingersoll-Rand Company, of New York City, the rescue work would have been seriously impeded. That office at once offered its services, together with a 5½x5-inch portable compressor and three CC-35 paving breakers that happened to be available.

The pneumatic tools quickly shattered the concrete and thus made it possible, shortly after their arrival, to remove 30 bodies from the ruins. Within ten hours they had broken their way through to the cellar, opening a passageway in time to come to the aid of two men who had miraculously escaped injury from the mountain of wreckage piled above their heads. For 120 hours the compressor was operated continuously by the engineers of the Ingersoll-Rand Company who stuck to their posts until all hope of saving more lives was abandoned.

The 5½x5-inch portable compressor arriving at the scene of the accident aboard a motor truck.

NEW FIRE EXTINGUISHER

A NEW 1-gallon fire gun or extinguisher that uses compressed air to expel the contained chemical is being produced by the Foamite Childs Corporation of New York City. The unit consists of two seamless brass cylinders fitted at the top and at the bottom into brass frame castings. One of the tanks is filled with F-R-X carbon-tetrachloride, and the other is charged with compressed air. When exhausted, the air tank can be replenished by means of a pump set between the cylinders, or it may be recharged from a compressed-air line.

The gun is provided with a gage that gives a visible record at all times of the available air pressure; and a glass window in the top of the chemical tank makes it possible to tell whether or not it is full. To apply the carbon-tetrachloride, it is necessary only to pull up a lever. This action releases the compressed air and also opens the outlet through which the chemical is discharged. According to the manufacturer, this extinguisher is especially suitable for use around electrical equipment, to quench oil fires, and in unheated buildings.

Ranges for the Housewife to Suit Every Taste and Requirement

The Fine Plant of the Cribben & Sexton Company is Equipped to Make One of These Commodities Every Two and a Half Minutes

By C. H. VIVIAN

PERHAPS no essential article of household equipment has undergone greater changes in recent years than has the kitchen range. For generations it was merely a "cook stove", and its appearance was ample evidence that its builders had in mind only its practical purpose. They produced a somber, grimy-looking object that begot grime. It was the bane of the housewife's existence, for, like the small boy's neck, it was continually in need of scouring.

The advent of gas for cooking brought with it a selling problem. Gas companies had to convince housewives that the new fuel was preferable to wood or coal, and one of their strongest arguments was based on its greater cleanliness. The absence of ashes, smoke, and soot made it possible to manufacture gas ranges which combined serviceability with pleasing appearance. In short, the range became a piece of furniture as well as something to cook on.

Recent statistics show that approximately 52,000,000 persons in the United States now eat meals that are prepared over gas. Of all our communities between 10,000 and 25,000 in population, 96 per cent have gas available, while 51 per cent of their homes burn gas for cooking. The percentages are even higher in the larger cities: every one with more than 50,000 inhabitants being supplied with gas. In those where the population is from 50,000 and 100,000, about 69 per cent of the housekeepers cook with this fuel, while the use of gas for this purpose extends to 80 per cent of the homes in communities of more than 100,000.

It is obvious that the work of manufacturing gas ranges has assumed proportions of some magnitude. Besides, it has now reached the point where new range models, incorporating improved designs or varied ideas of finish, or both, are placed on the market each year, emulating the custom in the automobile trade.

Among the larger firms engaged in making gas ranges is the Cribben & Sexton Company, of Chicago. This concern is the outgrowth of a business established 65 years back by Henry Cribben. Its original products were coal and wood stoves, hollow ware, and plumbing supplies. That part of the business devoted to the last-named line was sold 30 years ago. In 1912 the company began the production of furnaces, and nine years later it entered the gas-range field. Today it turns out the Universal and Home brands of gas ranges and the Universal furnace.

That the housewife has a wide latitude of choice in her selection of a gas range is evidenced by a comment by Carl E. Lyon, vice-president of the Cribben & Sexton Company, during a discussion of his firm's products. "We make our leading model—the 18-inch oven range—in several hundred different combinations," said Mr. Lyon. "First of all, there are the right-hand and the left-hand oven types. Each of these is finished in five standard varieties of trim. Each of the ten combinations that are thus created is made with equipment either for burning natural gas or artificial gas; each may be had with or without thermostatic heat control; with or without porcelain-enamel oven linings; with or without automatic lighters, and so on. These are all made from the same sets of dies and patterns."

When it is considered that each model comes in several sizes, that a combination gas-and-coal range is manufactured, and that the production of furnaces is an important

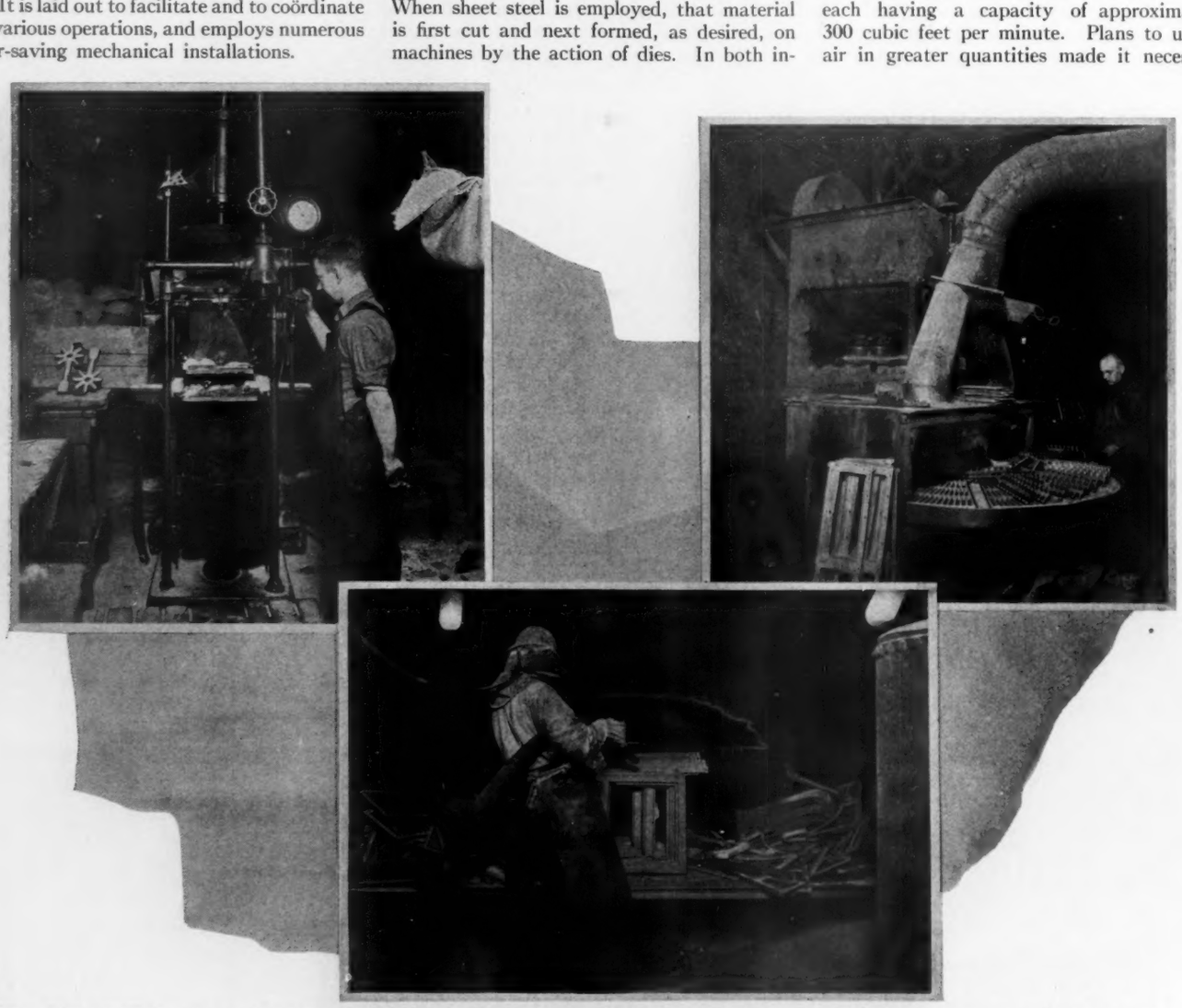
Front of the great plant of the Cribben & Sexton Company in which the offices and general show rooms are located.

branch of the business, it is hardly necessary to state that the factory of the Cribben & Sexton Company is of pretentious size. Suffice it to say that the land devoted to the activities has an area of more than 9½ acres, of which six are under roof; that one of the several buildings contains 230,000 square feet of floor space; and that the foundry work alone is done in a structure measuring 320x280 feet. The plant is modern in every particular. It is laid out to facilitate and to coördinate the various operations, and employs numerous labor-saving mechanical installations.

Furnaces are built almost exclusively of castings, so that the foundry is chiefly concerned with their manufacture. Heavier types of gas ranges call for many castings, while the lighter ones utilize sheet steel instead in many places. Although the parts of these two materials may be made by different methods, they are finished in much the same way. In the case of castings, they are poured in the foundry and then cleaned. When sheet steel is employed, that material is first cut and next formed, as desired, on machines by the action of dies. In both instances, the parts receive the same general course of treatment in the enameling department. Except for size and finish, some portions of the ranges, such as oven linings, are standard on all models. Gas pipes and certain trimmings on some of the ranges are finished in nickel. For their preparation, the plant maintains a modern electroplating department. The operations there are carried on by standard methods—the products being buffed on wheels after coming from the plating tanks.

Compressed air is an important agency in the factory. It saves time and labor in various ways and, consequently, reduces costs. Its chief uses are in the foundry and in the enameling department. Changes that have been made in the plant operations from time to time have increased the need for air. In 1925 only 600 cubic feet of air per minute served for all requirements. It was furnished by two compressors, a steam-driven unit of the FR type and a motor-driven unit, each having a capacity of approximately 300 cubic feet per minute. Plans to utilize air in greater quantities made it necessary to produce an additional 300 cubic feet per minute, or a total of 900 cubic feet.

In considering the matter of an increased air supply, officials of the company found that they could save money by installing a machine with a capacity of 600 cubic feet and taking out one of the 300-cubic foot units. Carrying out this policy, they purchased an Ingersoll-Rand 2-stage compressor of the latest type. Under ordinary operating conditions in the plant, this machine provides enough air for all needs; but when the load becomes too heavy for it, then the FR ma-



Top, left—The air-operated core-blowing machine that has considerably simplified the work of turning out cores for gas burners. Right—One of the numerous sand-blast outfits in the plant of the Cribben & Sexton Company. The parts on the revolving table have passed through the sand-blasting compartment and are being turned over by the operator for another trip through the machine. Bottom—One of the three sand-blast rooms where the cleaning is done by hand.

A gas range of the 6-burner type contains more than 500 separate parts. With the exception of a few small ones, such as bolts and nuts, gas cocks, and the patented thermostatic heat-control units, all are produced on the premises either in their entirety or the materials which enter into them undergo specific treatment to make them suitable for use. The fashioning of these parts engages most of the factory's facilities. Their assembly into the finished products constitutes a secondary, though important, phase of the plant activities.

chine is also brought into service. By this plan the second of the smaller compressors is held in reserve as a stand-by unit.

The air intake for the compressors is on the roof; and filters are provided so that the supply entering the machines may be free from the dust and foreign materials harmful to valves and other wearing parts. The discharge from the compressors is piped several hundred feet to receiver tanks, during which passage it cools considerably, causing condensation of the water vapor. Further moisture removal is effected by separators placed in the lines serving the sand-blast rooms.

and it is well arranged for the work done there. The cupola is placed in the center of the large room to conveniently supply metal to the molds, which are laid out on the floor surrounding it. Approximately 90 molders are employed; and during the course of a day's run about 34 tons of castings are poured. These vary in size from small pieces, such as range legs, grates, and burners, up to ash pits and radiators for furnaces, some of which weigh as much as 225 pounds each. The smaller molds near the cupola are filled with metal from long-handled ladles which are carried by the molders. Where

and packing it firmly around the pattern. Molding machines of this type do the work which formerly called for a number of men.

An air-operated core-blowing machine enables an attendant to turn out cores for gas burners in a fraction of the time required when hand methods were relied upon exclusively. Two molds, containing the patterns of the upper and lower halves of two cores, are assembled and placed on the machine, which blows sand into the recesses through small openings. Air at a pressure of from 85 to 100 pounds to the square inch is used in this operation. A skilled workman handles

Top—Rack laden with enameled gas-range parts that are ready to enter the furnace for burning. Bottom, left—Finished ranges leaving the end of the assembly line. Right—A corner of the large foundry, showing one of the portable air-operated molding machines. The air hoist, overhead, is used to handle the molds.

Experience has shown that the exclusion of moisture is an important consideration in the sand-blasting department. Many of the castings that go into the construction of ranges are coated with porcelain enamel, a finish that must be applied very carefully and that demands a clean, dry surface if it is to stand up in service. Trouble occurring at one time was traced to minute rust particles on castings that had been sand blasted. The difficulty was overcome after proper steps had been taken to remove substantially all moisture from the air lines.

As has been indicated, the foundry is a large and important department of the plant; greater quantities of metal are required, or where the distance of travel is considerable, the ladles used are suspended from overhead rails and moved by hand. Air-operated hoists prove highly effective in handling larger molds both during the molding operations and the shaking-out process afterwards.

Some of the smaller molds are formed by machine. This is a portable device actuated by compressed air through a cylinder underneath. After sand has been placed in the flask, a swinging arm is brought around and put in position just above it. The flask is then raised by the air cylinder, the action imparting a squeezing pressure to the sand several molds a minute, including the time spent in opening the molds after the cores are formed and in cleaning each mold with a compressed-air gun before it is placed on the machine.

The sand blast is one of the principal means employed in the cleaning of castings after they come from the molds. Three rooms for hand-operated blasting are provided. The castings are delivered to these enclosed compartments on trucks. Exhausters and collectors remove the dust from each room. The sand falls to the floor, and when a considerable amount has accumulated it is shoveled back into the hopper that serves the blasting equipment.

A sand-blasting machine also is utilized. It has a revolving table on which the pieces to be cleaned are carried into a compartment where three nozzles play sand on them from above. After they emerge, an attendant turns them over and they reënter the machine for the cleaning of the other side. While this equipment will handle pieces very rapidly and economically, still the hand-operated blast produces a superior and a more uniform finish.

Some of the castings are cleaned in metal tumblers, where they are scoured by steel jacks, loose pieces of angular steel. One of these machines in use is fitted with two nozzles, one at either end, which direct blasts of sand upon the castings as they turn over and over. Grinders, of both stationary and portable types, are used to remove from the castings projecting necks or ridges of adhering metal or of fused sand and metal; and air-operated chipping hammers also contribute to the finishing operations.

Enameling range parts by the use of the air spray.

Nearly all the exposed parts of ranges are attractively finished in porcelain enamel Inasmuch as many of them will be subjected to intense heat in service, extreme care must be taken in the enameling process to insure a durable product. The parts must be absolutely free from oil, or the enamel will not adhere well. Sand blasting adequately cleans the castings. Steel parts are cleansed in a caustic solution and are pickled in a weak acid bath to remove scale.

The enamel is applied by air spray, a number of booths being provided for the purpose. First a ground coat of black is put on. Next come two coats of finish of any desired color. After each application, the parts are dried and then heat treated to harden the coating. The parts to be enameled are placed on a rack, one at a time, and are sprayed by an operator who holds the enamel gun so that the spray is directed at a 90-degree angle to the surface of application. This produces a uniform coating. Spraying has several advantages over dipping. It conserves material by applying it only to the side which it is desired to coat, and it prevents "runs" of enamel that cannot be avoided when dipping is employed.

Air at a pressure of from 80 to 85 pounds is used for the spray guns. This enables them to handle a larger volume of material than would be the case if air at low pressure were utilized. By thus allowing the spray to cover a wider area of surface at a time the operation is speeded up. Many of the enameled pieces are finished with a black border. This is accomplished by burning on the ground coat of black and by removing, before burning, the subsequently applied and overlying finishing coats. At that stage the enamel is in the form of a powder and is easy to wipe off.

The enameled pieces are burned in large furnaces, being wheeled into position on frames capable of holding several hundred articles. The furnaces are fired by gas, which is taken from the mains and compressed to approximately 15 pounds to the square inch before being piped to the burners. The length of the burning period and the temperatures used vary with different materials. For instance, enameled sheet-steel parts require only about three minutes' treatment at a temperature of 1,500° F., whereas it takes 20 minutes at a temperature of from 1,600 to 1,650° F. to burn a coating on cast iron. Some range models have oven linings finished with an aluminum-alloy paint. Like the enamel, this finish is applied by spray guns. Further use for air painting is found in the japanning of certain parts.

The machines that turn the sheet steel into the desired forms are motor driven and of the most modern type. Compressed air is utilized in one of the larger units in a cushioning cylinder; and it also serves to clean the dies. There are complete machine shops for carrying on the numerous operations which are involved in preparing the range parts.

The ranges are put together on a moving assembly line, the workmen stationed along it adding one or more parts to each unit as it passes them. When working to full capacity, this line calls for 31 assemblers; and it moves at a speed which produces a completed range, crated for shipment, every 2½ minutes.

The company maintains an attractive display of its products in that section of the factory devoted to the general offices. These rooms front on Sacramento Boulevard, a street of heavy automobile traffic. To make capital out of the advertising opportunity thus presented, various models of ranges are mounted behind large show windows and are flood-lighted at night so that they can be plainly seen by those passing.

To ascertain the popularity of the different models with the public and to regulate production properly, the company closely checks sales every three months. This "sales experience", as it is known, makes it possible to coordinate production with stocks on hand and to gage with fair accuracy the future market demands. Stocks and distribution branches are maintained in various parts of the country. The officers of the Cribben & Sexton Company are: G. D. Wilkinson, president and treasurer; W. A. Smith, vice-president and general manager; Carl E Lyon, second vice-president; and H. A. Shannon, secretary.

A monolithic mass of marble, weighing 400 tons, in the Carbonera quarries, near Carrara, Italy. The stone will form an obelisk to be erected in La Farnesina, Rome.

America Controls World Supply of Helium

By C. MORAN

SIXTY years ago a group of scientists who were observing an eclipse of the sun in India detected a bright yellow line which was destined at a later day to revolutionize air navigation. They discovered in that part of the atmosphere of the sun—about 10,000 miles deep—which merges into the corona, an element not theretofore found on earth, and which they named "helium".

Recent discoveries of helium-bearing gas by Government scientists exploring the Cliffside natural-gas structure in the Panhandle district of Texas, together with the construction of two dirigibles three times the size of the *Los Angeles*, promise to place the United States in the forefront of air navigation. A helium-production plant now being completed near Amarillo, Tex., will furnish helium for many years to come, and give the United States Government a practical monopoly of the world's supply of this noninflammable gas essential for the safety of dirigibles.

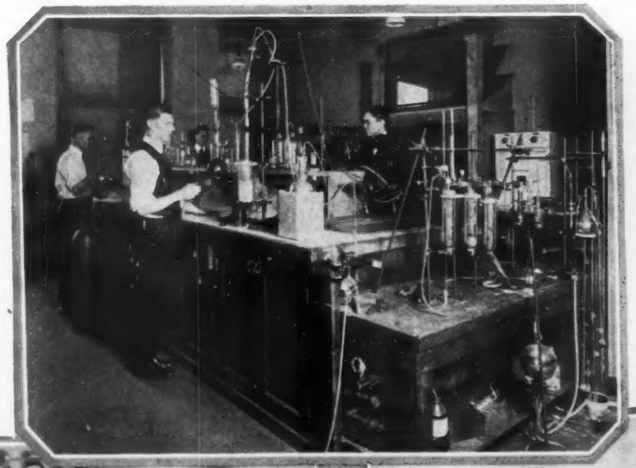
The two new airships, contracts for the building of which were signed recently by the Navy Department, will have a cruising radius of 9,000 miles at a speed of 72 knots per hour. Each ship will contain eleven separate cells of helium, and within the hulls of each there will be airplane hangars capable of accommodating five scouting planes. Experimental flights are now being made with the *Los Angeles* to determine how planes can be landed and flown from dirigibles. The new ships will be designated as the *ZRS-4* and the *ZRS-5*, and are expected to be ready for service during the summer of 1931.

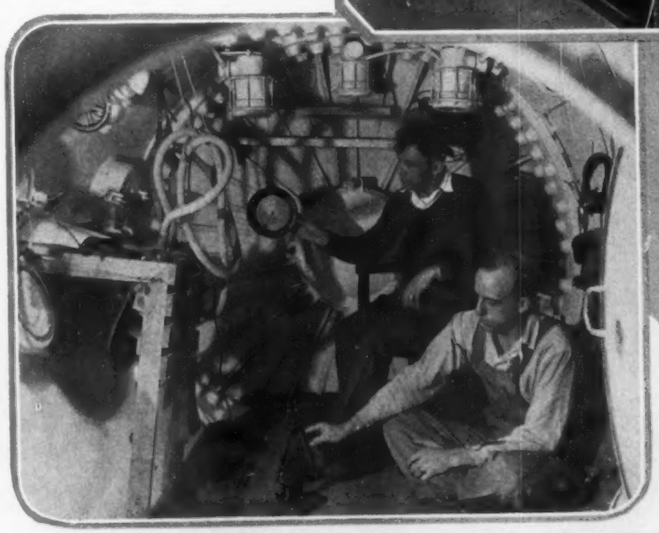
Helium research has been conducted by the United States Bureau of Mines for the last ten years, and all the American dirigibles since the construction of the United States Navy *C-7* have used this rare noninflammable gas. Its scarcity, however, and the heavy expense involved in its manufacture, threatened to place a practical limit upon production until the discovery of the presence of helium in large volume in the Cliffside natural-gas structure. Some 26,000 acres of land cover this structure—each well making available daily an open flow of 9,000,000 cubic feet of natural gas, from which the contained helium is to be extracted.

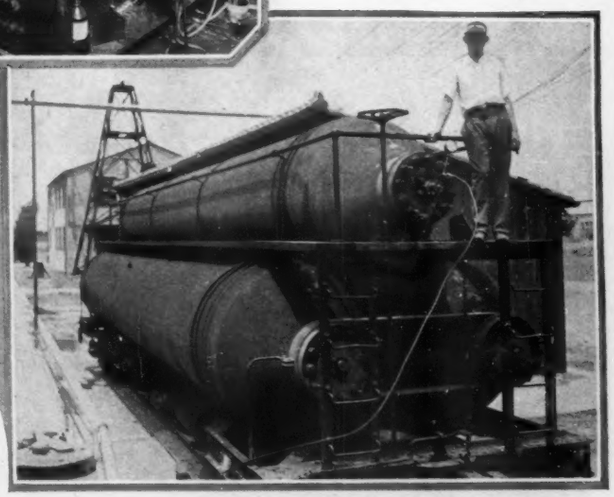
Fire was so serious a potential source of destruction of the *Graf Zeppelin* during its flight that smoking aboard was strictly prohibited. In warfare, a single bullet might destroy a hydrogen-filled ship. Helium is the only noninflammable gas which is light enough to replace hydrogen as a lifting force and which has the additional advantage of diffusing through a fabric at about three-quarters the rate of hydrogen. Its noninflammability makes it possible to place the engines in the framework of the dirigible, thus getting a direct drive resulting in greater control of the craft and increased speed for any given horsepower.

If future argosies of the upper ether are to offer the real assurance of safety necessary to their success, declare the Government investigators, the huge cigar-shaped envelopes which contain the lifting gases must be filled with helium. The dirigibles operated by the United States Army and Navy are provided with this gas, but all foreign-owned aircraft must depend on highly inflammable hydrogen for the inflation of their huge gas bags. The United States is the only nation which has developed its helium resources and brought production to a commercial stage.

Approximately 2,500,000 cubic feet of helium is required to fill the envelope of the *Los Angeles*, and nearly three times as much will be needed for each of the new dirigibles. The Petrolia field in northern Texas, which has been the principal source of our helium, is rapidly becoming exhausted, and new fields had to be discovered by the Government scientists if the United



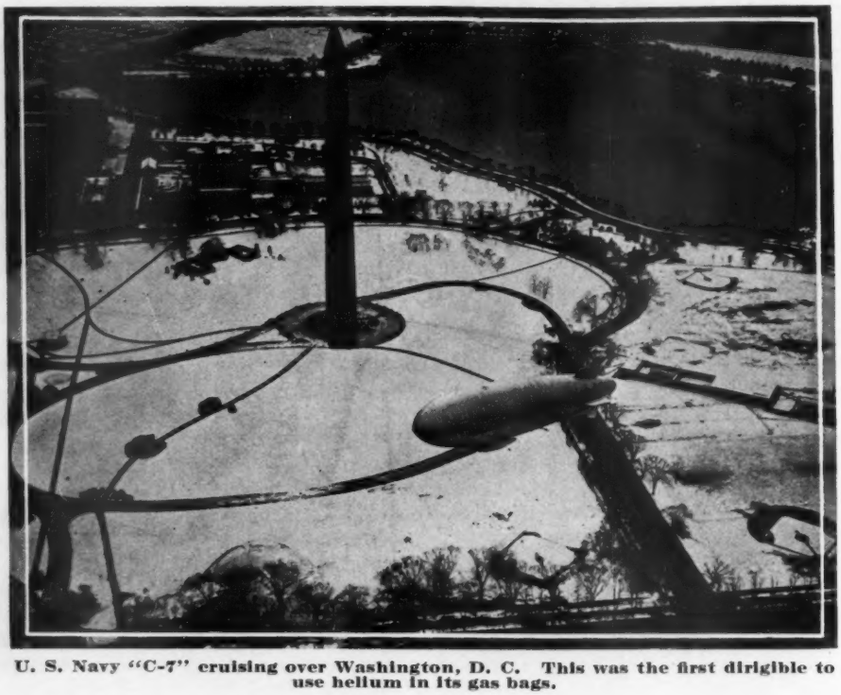




Top—In the Cryogenic Laboratory of the Bureau of Mines, where most of the Government's helium research has been done. Bottom, left—Diving experts of the United States Navy experimenting with helium-oxygen gas in the "iron doctor" or decompression chamber. Right—Charging a specially built tank car with helium at Fort Worth, Tex. These cars carry about 200,000 cubic feet of the noninflammable gas at 2,000 pounds pressure per square inch.

States were to retain its advantage.

The tasks of furnishing this vital helium and of finding new fields have been assigned to the Bureau of Mines, which has kept Uncle Sam in helium for several years past and which has produced more than 90 per cent of the world's supply. For many months the chemists of the bureau have been analyzing samples of natural gas obtained from hundreds of fields, always looking for the characteristic bright-yellow line which, viewed through the spectroscope, announces the presence of the much-prized helium. This analytical work has resulted in valuable data regarding the helium content of different gas fields; and the question as to where Uncle Sam is to obtain his helium, for some time to come at least, has been answered, so it seems, by the Cliffside natural-gas structure.



U. S. Navy "C-7" cruising over Washington, D. C. This was the first dirigible to use helium in its gas bags.

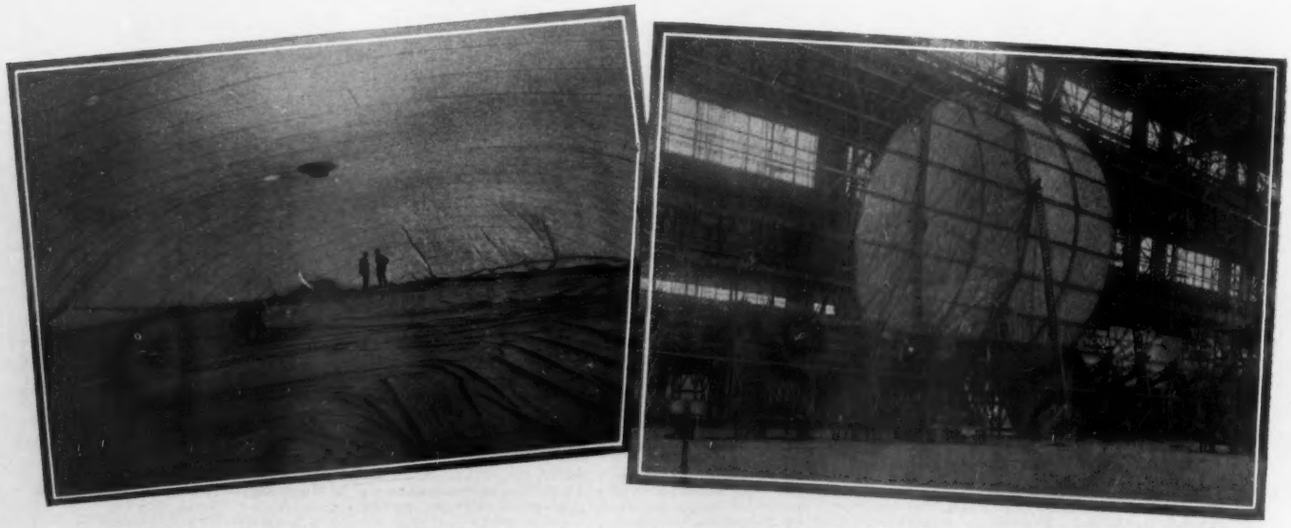
A big helium production plant, embodying the results of thorough research on the part of the bureau's specialists, is nearing completion near the townsite of Soncy, about six miles west of Amarillo; and from the natural gas in that field, which has a helium content of about 1¾ per cent by volume, will be extracted the supplies needed to keep aloft America's giant dirigibles of the future.

In the new Amarillo plant, the helium will be recovered by cooling the gas to approximately 300° F., below zero, at which temperature all the constituents of the gas, except the helium, are reduced to a liquid state. At this low temperature the helium will be drawn off as a gas and compressed into tank cars or steel cylinders for shipment to points where it will be needed in lighter-than-air craft and for other purposes. The extremely low temperature to be used in the plant will be produced by the compression, cooling, and subsequent expansion of the gases. At the minimum temperature, atmospheric air is a liquid, mercury and carbon dioxide are solids, lead and copper take on properties of steel, and rubber is almost as brittle as glass.

The Cryogenic Laboratory of the Bureau of Mines at Pittsburgh, Pa., has been the scene of the Government's helium research work. Because of the very low temperature at which certain operations are conducted there it has been called "the coldest spot in the world." Before the United States entered the World War, helium had been obtained in but small amounts and as a curiosity in the Cryogenic Laboratory—the total quantity recovered not exceeding 100 cubic feet at a production cost of about $2,000 per cubic foot. Since then, the cost has been reduced to three cents per cubic foot!

In service, in dirigibles, helium escapes and air enters through the walls of the cells containing the gas, so that the helium must be removed at intervals, purified, put back, and replenished. A new helium purification plant constructed for the Army Air Corps by the Bureau of Mines is capable of purifying 10,000 cubic feet of helium per hour. Other repurification plants, both stationary and on railroad cars, are in use by the Navy.

Recent researches with helium have demonstrated the value of the gas in deep-sea diving and caisson work. Helium-oxygen atmospheres are being used today in our naval diving schools so as to increase the depth to which divers may go and to lengthen the time they may remain underwater. This synthetic gas has been found of value in treating cases of "bends" in the medical air-lock in which decompression may be controlled. Without its aid it would take as long for a diver to be raised through the various pressure zones as he has labored on the bottom; but, thanks to helium, this interval can be reduced more than 50 per cent. By thus extending the reach of the diver and also the time in which he can work effectually, it will be possible to undertake salvage operations at points hitherto inaccessible.



Left—Inside one of the big gas cells of a giant airship. Right—Gas cell in position in the framework of a dirigible.

Linking Up the World By Radio

Present-Day Status of This Comparatively New Means of Communication and Its Potentialities

By W. H. BARSBY

IN the heart of the downtown district of New York, close to the financial and business pulse of the world, there is located one of the most amazing and far-reaching enterprises of this ultra-scientific age; a modern Aladdin at whose command genii of the ether annihilate space and time with fabled swiftness, and bring back instantaneously magic treasure to be laid at the feet of American business. The age of miracles is not past, for it is impossible to go through the Central Radio Office of the Radio Corporation of America at 64 Broad Street without marveling at the ingenuity man has displayed in harnessing the forces of nature to his yoke and compelling them to do his bidding. Here, literally, is the nerve center of the vast RCA international radio-communication system—its invisible but none the less powerful fibers transmitting the impulses of modern business over continent and ocean to more than a score of foreign countries and bringing the whole world to our very desks.

To the man in the street, "radio" means "broadcasting", and in view of the rapid development of this phase of the radio art during the past few years, coupled with its tremendous popular appeal, it is perhaps natural that the two words have come to be regarded as synonymous. It is none the less true, however, that the original conception of radio, or wireless as it was then known, contemplated primarily the provision of a new means of commercial communication to supplement the services furnished by telegraph wires and submarine cables.

More than 32 years have passed since Marconi filed his first patent for wireless telegraphy and succeeded in communicating over a distance of something less than two miles. The immense value of the new invention in destroying the isolation of ships at sea was at once apparent; and the earliest practical applications of the art were logically from shore to ship, and ship to shore.

The memorable collision between the S. S. *Republic* and the *Florida* off Nantucket, in January, 1909, demonstrated in a most dramatic way the humanitarian possibilities of radio, and with the sinking of the *Titanic* in 1912 the art received further impetus. Radio was instrumental in saving hundreds of lives in those two disasters alone; and it was not long before every passenger ship was compelled to carry radio equipment for the safeguarding of life and property at sea.

Several years prior to this, Marconi had succeeded in spanning the Atlantic with his now historic letter "S" signal; but, even so, commercial transoceanic communication was still far from practicable. Although many attempts were subsequently made, it remained for American inventive genius to design and to build the first high-power apparatus capable of maintaining continuous and reliable service between the United States and Europe. This came with the development of the Alexanderson high-frequency alternator; and so revolutionary were the results obtained by its use that an installation was made for the United States Navy during the war. This alternator demonstrated its practicability by carrying a great part of the tremendous volume of government correspondence that passed between this country and Europe during the period of hostilities and reconstruction.

Immediately following the war, strenuous efforts were made by powerful foreign interests to obtain control of the Alexanderson patents with the object of securing to themselves supremacy in world radio communication, and it was at this crucial juncture that the Radio Corporation of America was formed at the urgent appeal of our Navy to develop those important devices for American use and to wrest world leadership in international radio communication from the eagerly outstretched hands of foreign competitors.

On March 1, 1920, the first commercial transatlantic radio service was opened between the United States and Great Britain; and, simultaneously, transpacific radio services to Hawaii and Japan were offered to the public. Rate reductions ranging anywhere from five to twenty-four cents per word were made as compared with the existing tariffs, and American businessmen were not slow to take advantage of the substantial

Photos, courtesy Radio Corporation of America.

Main power plant and cooling tank of the Radio Corporation of America at Rocky Point, Long Island.

savings made possible by this new means of communication.

As fast as facilities could be provided, new circuits were put into operation to Norway, Germany, France, Italy, and many other points until, at the present time, RCA maintains direct and continuous service with no less than 26 countries in Europe, Asia, Africa, South America, and the West Indies, and, through its connections with foreign telegraph administrations, is able to forward radiograms to nearly every country in the world.

The history of international radio communication is a continuous record of development and achievement. The original methods of operation, necessitating for each circuit a high-power transmitting station with a corresponding receiving station, both of them remote from the source of business, proved costly and inefficient. Messages had to be relayed over telegraph wires to and from New York City and the wireless stations in Massachusetts, Long Island, and New Jersey, and it was soon realized that more direct means would have to be utilized if radio were to become a serious competitor of the established systems.

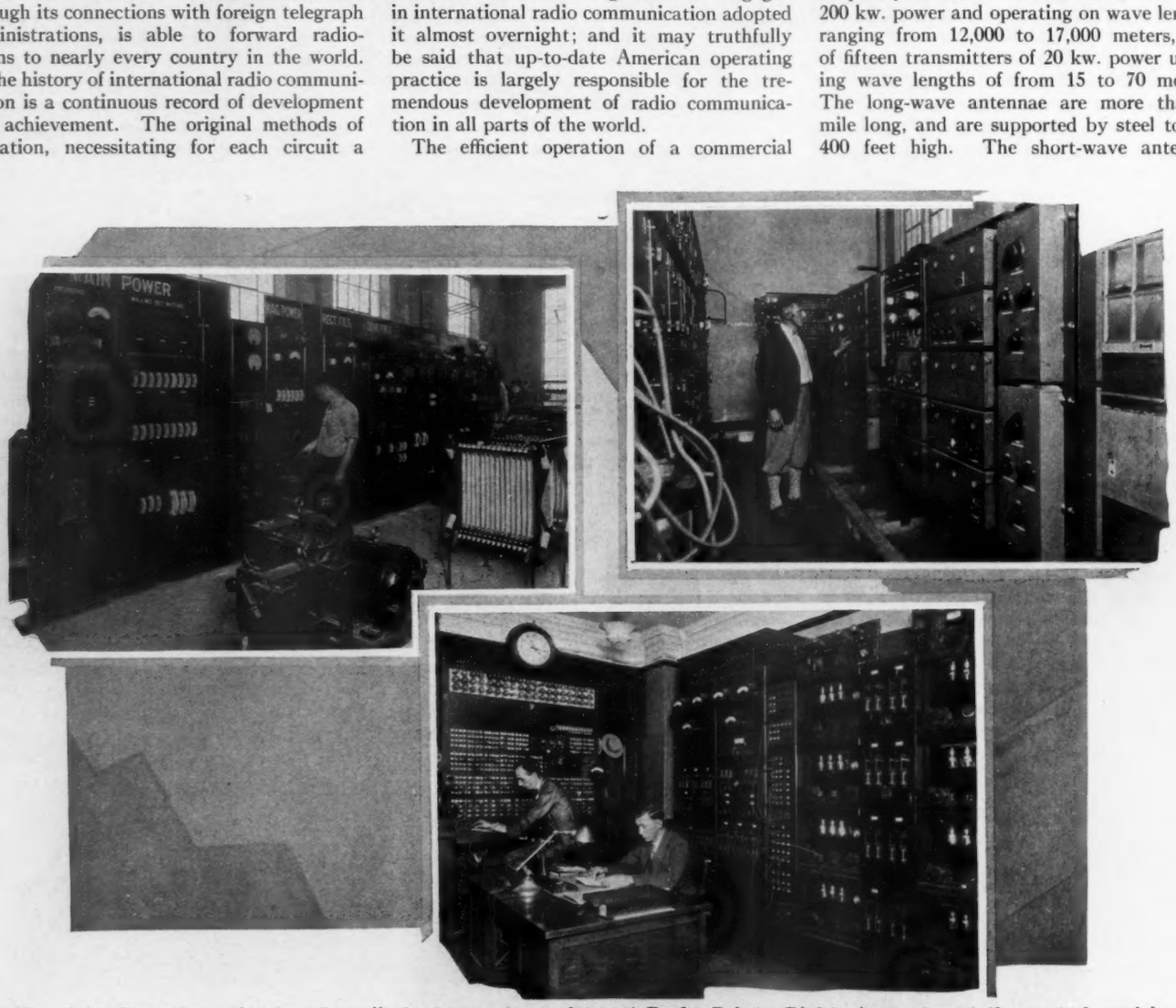
The problem was solved in less than a year, for by the spring of 1921 a completely new system, known as "central-office control", had been devised and installed. The fact that this meant the scrapping of several million dollars worth of plant and equipment was incidental—service was the first and only consideration then as now; and within a short time after the change had been made, radio loomed up as a real factor in telegraphic intercourse. Indeed, the efficiency of the system was so marked that most of the foreign administrations and organizations engaged in international radio communication adopted it almost overnight; and it may truthfully be said that up-to-date American operating practice is largely responsible for the tremendous development of radio communication in all parts of the world.

The efficient operation of a commercial long-distance radiotelegraph circuit requires, first of all, a considerable tract of land for the erection of the necessary towers, antennae, power plant, and auxiliary apparatus, and this precludes the possibility of such an installation being made within the confines of a large city. At the same time it is absolutely essential that the terminal transmitting and receiving operations shall be performed as close to the source and destination of the traffic as practicable. Centralized operation provides the ideal solution.

Most of the transmitters used in the RCA transatlantic and South American services are concentrated at Rocky Point, L. I., about 70 miles from New York, although additional transmitters in Massachusetts and New Jersey are available. These transmitting stations are connected by telegraph control wires with the central radio office in the Metropolis.

The transmitting plants on the eastern seaboard comprise eight Alexanderson high-frequency-alternator installations, each of 200 kw. power and operating on wave lengths ranging from 12,000 to 17,000 meters, and of fifteen transmitters of 20 kw. power utilizing wave lengths of from 15 to 70 meters. The long-wave antennae are more than a mile long, and are supported by steel towers 400 feet high. The short-wave antennae occupy much less space, although the various improved types of "beam" and "projector" aerials are quite complicated in their structure and arrangement.

There are no operators at the transmitting stations, as all transmission is controlled direct from the New York office by means of automatic Wheatstone sending machines which give steady and uniform signals over a speed range of from 25 to 250 words per minute. These Wheatstone machines are connected by direct telegraph wires to relays at the transmitting station proper, and these, in turn, control the relay systems of the actual transmitters, thus energizing the various



Top, left—Control panels of a "beam" short-wave transmitter at Rocky Point. Right—Apparatus at the central receiving station at Riverhead, Long Island. Bottom—Telegraph switchboard and "tone-channels" at Riverhead by means of which signals are automatically transferred to the central office in New York City.

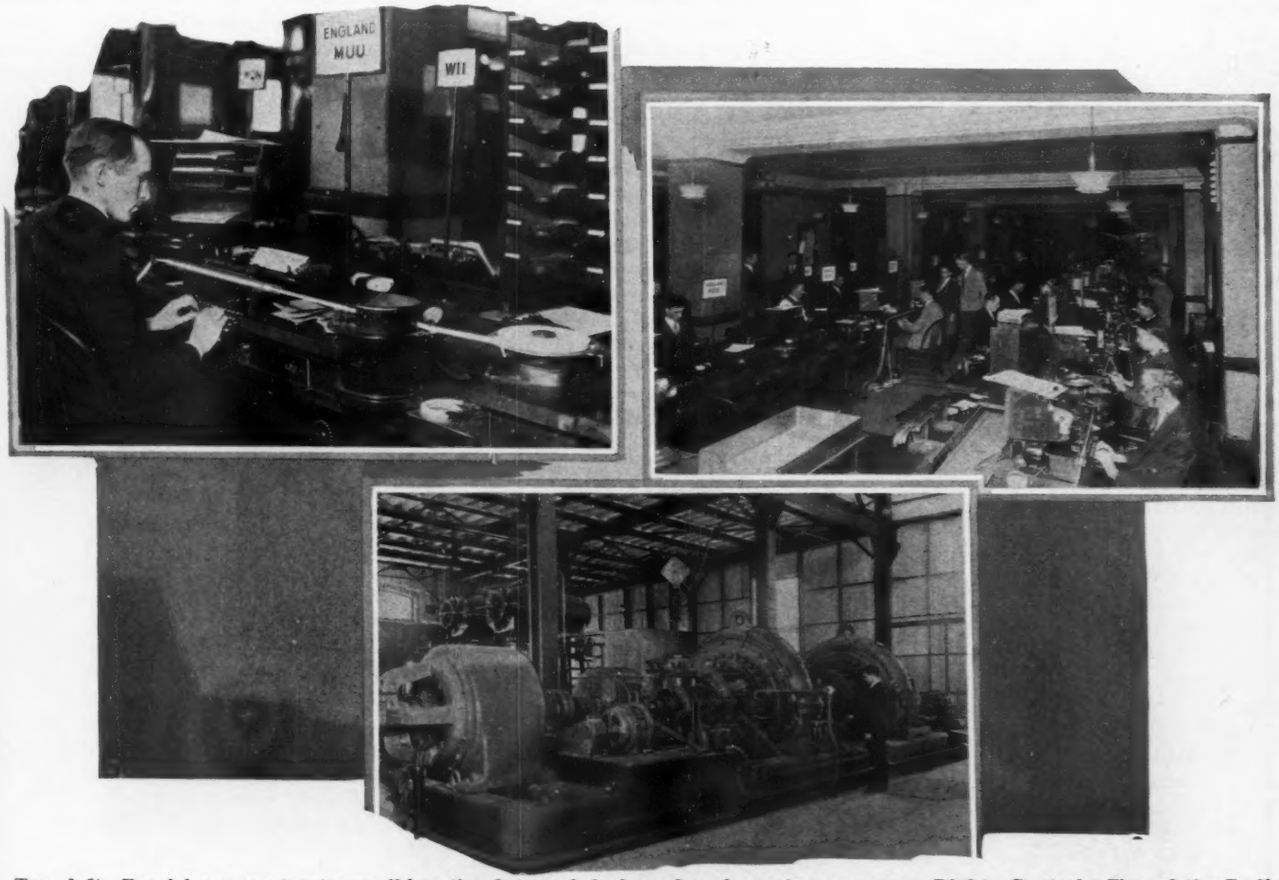
antennae and flinging the signals in a fraction of a second right across the ocean. For all practical purposes the transmitting station, itself, is simply a large power plant, and the engineers and attendants are charged only with the proper maintenance and adjustment of the apparatus.

The simultaneous reception of radiograms from many different countries is carried out at a central receiving station located at Riverhead, L. I., about sixteen miles from Rocky Point. The main antenna is nine miles long, but only about 20 feet high; and it is possible to receive and to separate without interference any number of signals. This antenna, known as the Beverage Broadside Antenna System, is highly directional and efficient in its operation, and is designed primarily for the reception of long-wave signals from Europe. Short-wave signals are received on antennae of latest design that incorporate all the directional and other features developed over many years' research. The receiving apparatus is housed in modern fireproof buildings and is installed in electrically shielded box units of uniform height, each long-wave receiver occupying one section of a multiple-tiered rack, some 20 feet in length, which accommodates four complete receivers, one above the other.

Signals are transferred automatically to the central radio office in New York. Special "tone channels", consisting of the highest type of telephone circuits and carried in cable for the entire distance, are employed for this purpose. Audio-frequency signals are fed into them at Riverhead and pass through special amplifier-rectifier units at New York to operate the automatic tape-recording machines on which the dots and dashes of the international Morse code are printed.

A visit to the central radio office in New York, the clearing house for radio communications to and from all parts of the world, is illuminating. As the visitor enters the main operating room on the second floor he is greeted by a babel of muffled sound that is rather bewildering. There is heard the staccato click-click of the electric keyboard perforators on which all radiograms for transmission are prepared for the Wheatstone transmitters—the hum of high-speed motors operating various devices—the clickety-clack of countless typewriters turning out hundreds of radiograms from a score of countries as the operators feverishly scan and decipher the moving tapes in front of them—the purr of conveyor belts with their never-ending load of incoming radiograms on their way to delivery—the sput-sputter of automatic telegraph printing machines feeding more grist to the mill from outlying branch offices, while electric time stamps automatically and methodically record the exact minute each radiogram is received. Small wonder, then, that the layman fails to reconcile his preconceived ideas of what a radio office should be with the reality.

Long rows of tables, crowded with unfamiliar-looking apparatus that has none of the characteristics of radio, greet the eye; neat signs, labeled "Great Britain", "Germany", "Argentina", and a score of other countries, furnish a lesson in geography; neon lamps glow fitfully and redly; the pens of the siphon recorders jiggle up and down at furious speed, leaving undulating trails of ink on the narrow paper tapes that reel off yard by yard in front of the receiving operators—the whole scene is one of extraordinary hustle and activity.



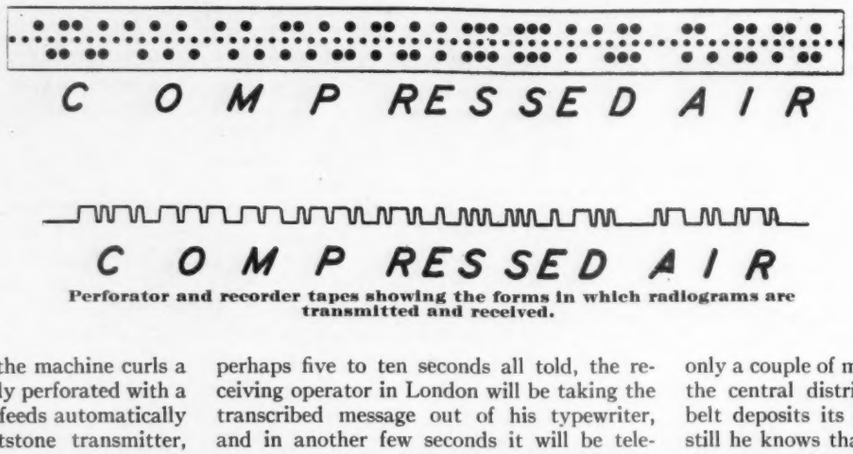
Top, left—Receiving operator transcribing the dots and dashes of an incoming message. Right—Central office of the Radio Corporation of America, in New York City, where radiograms are sent to and received from every part of the world. Bottom—One of the Alexanderson high-frequency alternators, in the power plant at Rocky Point, which make continuous and reliable service possible between the United States, South America, and Europe.

The long table running the length of the room with some fifteen or twenty operators seated on either side a few feet apart is the brain of the system. From it the voice or, rather, the handwriting of the United States is being hurled over all the world, for here are concentrated the controls of every transmitter used by RCA in its transatlantic and South American services. This man is sending to Paris; that man is communicating with Argentina; over there radiograms to Turkey are being dispatched—all with the speed of light and with unbelievable accuracy.

Here's a message going to London. It's an important one, for the sender maintains

a special telegraph wire from his brokerage office to the RCA "Central" so that he may eliminate the delay of calling for a messenger. The radiogram is placed in front of one of the operators who sits at a keyboard machine resembling a typewriter but which has most of its mechanism enclosed in a soundproof cabinet. His fingers spring into action; and from the left side of the machine curls a narrow paper tape curiously perforated with a series of holes. This tape feeds automatically into the adjacent Wheatstone transmitter, the levers of which move up and down through the perforations at terrific speed as the tape is pulled through the machine by a fine-toothed wheel, control one of the beam transmitters at Rocky Point. A speedometer attachment on the machine shows that it is sending at a rate of 150 words per minute. After the operator has stamped the exact time of transmission on the face of the radiogram by means of an electric time stamp, he starts perforating the next message, for the Wheatstone eats up tape by the yard, and there must be no stop.

How long will it take to get to London? By the time the last perforation of the tape has gone through the transmitter, a matter of perhaps five to ten seconds all told, the receiving operator in London will be taking the transcribed message out of his typewriter, and in another few seconds it will be telephoned or telegraphed over a private line to the addressee at the London Stock Exchange.

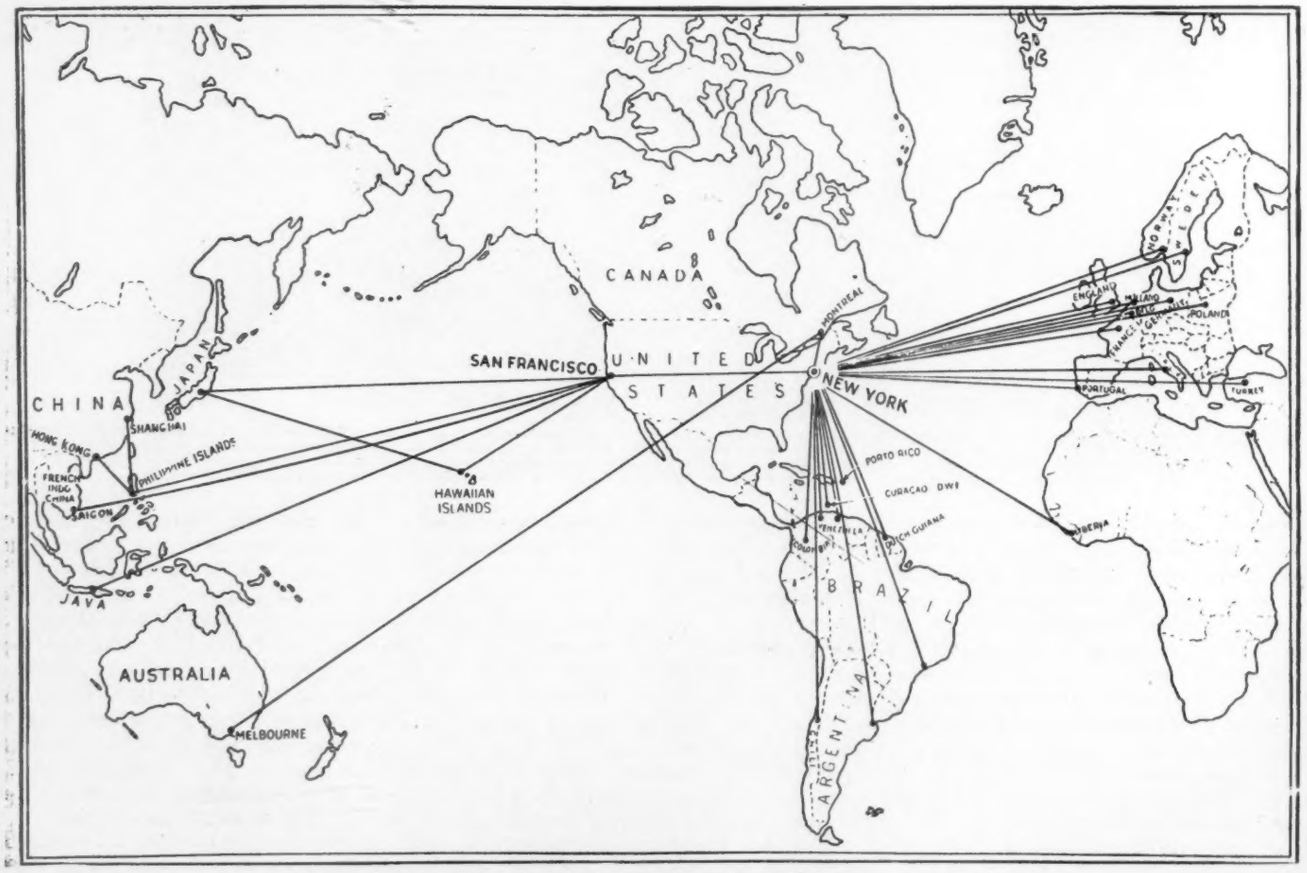


Perforator and recorder tapes showing the forms in which radiograms are transmitted and received.

Incredible? Yes, but wait a moment. Let's go around to that other table where radiograms from London are being received. Here we are. See those wavy lines on the tape as it comes from the recorder? That's the way the message you just watched on its way to London looked at the other end. Both the perforations on the transmitting tape and the undulations on the recorder tape represent dots and dashes, and to a skilled operator their meaning is as plain as if they were Roman type.

Ah, yes, here it comes! You may not believe it, but the message the operator is now transcribing is a reply to the one that was sent just two minutes ago. You see, not only was delivery in London made by private wire but the reply was filed in the same way, and you already know that the actual transmission is only a matter of seconds. No, the operator doesn't put that one on the conveyor belt as he does most messages, for while it takes only a couple of minutes for it to pass through the central distribution point at which the belt deposits its load of incoming messages, still he knows that there is a private wire to the office of the addressee. So a boy takes it directly from the London circuit to the telegraph wires over on another table. That short circuit in routine saves two minutes, and minutes are dollars. If we walk over there now, we'll find that the radiogram has already been delivered. The complete round trip from New York to London and back was made in less than three minutes! Amazing, isn't it? But that's what radio has done for the businessman.

Buenos Aires or Constantinople is just as near to New York in point of time as London or Paris, for the impulses that are sent out from that long, narrow table travel at the rate of 186,000 miles a second. Unlike the



The direct circuits of the world-wide system of the Radio Corporation of America.

submarine cable, radio goes direct to its objective, and even though that objective be far remote from the coast, or high in the mountains, or in the middle of a desert, radio flies quickly and truly to its goal.

It is this ability to overcome physical obstacles that confers on radio one of its greatest advantages over other means of communication; and it is destined to play a great part in the future upbuilding of countries that heretofore have suffered comparative isolation. Our history, and the history of other nations have shown that quick as well as cheap communication has been the greatest stimulus to the development of foreign commerce. The commercial growth of many lands has been retarded because of a lack of adequate communication facilities, particularly where the initial returns would not justify the expense of laying a cable. Fortunately, in such circumstances, radio can furnish direct intercourse between countries which otherwise would be compelled to use roundabout means entailing the delays incident to frequent and time-consuming relays.

The quality of service, both as regards speed and accuracy, has necessarily improved with the establishment of keenly competitive routes, and neither cables nor radio can afford to stand still for a moment. Research and development are going on continually at tremendous expense, for radio not only has to withstand its cable competitors in this country but it also has to maintain and to solidify its recognized position of leadership in world radio which was secured to the United States immediately following the war and which several foreign nations are making vigorous efforts to dispute.

The foreign trade of this country has more than doubled since 1913, and this expansion in international commerce has necessitated additional channels of communication. Naturally, with the steadily increasing volume of radio and cable traffic, faster and more economical methods of handling must eventually be found, for while the volume trend is distinctly upward the natural tendency is towards lower and lower rates. A partial solution in the radio field has come with the development of ultra-short wave lengths. Not only is the initial cost of a short-wave installation very much less than that of a transmitter of the alternator type but the speeds at which operation is practical are infinitely greater. Equipment of the beam and projector types are now superseding the older apparatus; and continuous operation over thousands of miles at speeds ranging up to 200 words per minute is quite practicable.

A further advantage of this method of operation lies in the fact that it confers practically absolute secrecy on radio communications. There are two main reasons for this: first, that the transmission of energy in a narrow beam directed on a focal point makes it impractical for signals to be picked up except in the angle of projection; and, second, that the speed of transmission permitted by this system is so great—100 to 250 words per minute—that an intelligible signal can be received only on specially designed and extremely sensitive recording apparatus. The casual listener would hear nothing but a confused and meaningless blur of sound that is not even recognizable as dots and dashes.

This is only the beginning, however. The day is not far distant when the present system of transmitting in dots and dashes will have become obsolete and facsimile operation will have taken its place. Such a system will reproduce at the receiving end an exact duplicate of the original message, whether it be typewritten or couched in hieroglyphics. The first step in this direction was made more than two years ago, when a commercial photoradio service for the transmission of photographs, drawings, legal documents, advertisements, etc., was introduced by RCA between New York and London and between San Francisco and Honolulu. Hundreds of commercial pictures have been handled by this means; and its application to ordinary messages is inevitable as soon as further refinements in the apparatus have been developed to the point where economical operation is possible at a low cost to the user.

What such a revolutionary change will mean to the businessman is readily apparent. Errors will be eliminated; trademarks and sketches may be introduced into the message; identification of the sender by his handwriting may be definitely established; intricate and complicated legal instruments and documents may be sent as a unit; checks and drafts may be instantaneously forwarded to any part of the world with a minimum of trouble and expense, while a whole page of newspaper print could be forwarded in a fraction of the time and at a tithe of the cost that its transmission by present methods would involve. Such a service is not merely a possibility—it is absolutely certain to be available within a comparatively short time, and all of it must inevitably react favorably to business.

In furnishing rapid and accurate service to the twenty-six countries with which direct communication is maintained, RCA has two central offices—the one in New York, referred to in this article, and a second in San Francisco for the transpacific services. It also owns and operates stations and offices in Hawaii, the Philippines, and Porto Rico, and has a number of branch offices in New York, Boston, and Washington for the acceptance and delivery of radiograms. Transatlantic radiograms originating in or destined to other points in the United States are handled by the Postal Telegraph Company, while those to and from transpacific countries are handled internally by the Western Union Telegraph Company. In either case, the insertion of the routing indication "Via RCA" insures their transfer at New York and San Francisco, respectively, for transmission by radio.

Countries with which the United States is in direct radio communication include: England, France, Germany, Italy, Norway, Sweden, Poland, Holland, Belgium, Portugal, Turkey, Liberia, Argentina, Brazil, Colombia, Venezuela, Dutch Guiana, Porto Rico, Dutch West Indies, Hawaii, Japan, Philippines, French Indo-China, Dutch East Indies, Hongkong, and Shanghai, while additional direct services will be opened in the near future to Spain, Denmark, Czecho-Slovakia, Russia, Cuba, Chile, Mexico, South Africa, Australia, and other points. The value to American business organizations of such a comprehensive network of fast communication channels needs no emphasis; but it is certain that the successful efforts of this country to expand its foreign trade have been greatly facilitated by the advent of radio into the international communication field. and that business generally has found it to be a new and powerful ally.

PAPER-MILL WASTE YIELDS VALUABLE PRODUCTS

AS the result of a process developed by Dr. Erik L. Rinman, a Swedish chemist, another waste product, this time of the paper industry, is being made to yield numerous valuable by-products. "Black lye", obtained in the manufacture of chemical pulp, is converted by him into methyl alcohol, acetone, methylethylketone, acetone oil, light and heavy tar oils, turpentine, and so-called "soda-coal".

The first step in the process is to reduce the waste liquor, in a vacuum, to a treaclelike substance, which is then carbonized in retorts at a temperature of not more than 750° F. The soda coal is the residue from the retorts, and consists essentially of sodium carbonate and free carbon, which is burned in a new type of mechanical stoker. More than 97 per cent of the carbon is consumed—the heat being used in the generation of steam, while the sodium carbonate is extracted with water and reconverted into caustic soda.

According to *The Engineer*, the process is now being utilized in a plant, at Regensburg, Bavaria, that turns out 600 tons of pulp a month. The capacity of this plant, which is in charge of Doctor Rinman, is soon to be increased to 2,000 tons monthly. For every 1,000 tons of Kraft pulp produced, the mill yields 25 tons of methyl alcohol, 18 tons of acetone, 18 tons of methylethylketone, 12 tons of acetone oil, 8 tons of light oil, and 50 tons of heavy oils.

The American petroleum industry is said to have applied to the Federal Radio Commission for licenses to operate about 60 short-wave transmitters which are to be utilized in locating new oil fields. The statement is made that oil to the value of $100,000,000 has already been discovered by geophysical exploration, which makes use of the lag between radio and sound transmission to determine the geological formations under the earth's surface—the velocity of the sound waves being affected by the presence or the absence of deposits of salt which are frequently associated with accumulations of petroleum.

OUR CONTRIBUTION TO "GRAF ZEPPELIN'S" RETURN TRIP

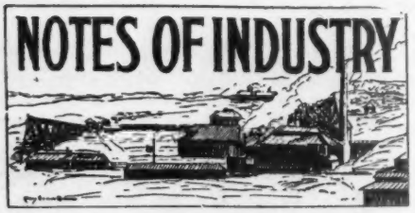
AN interesting story has come to light regarding the fuel gas burned in the motors of the *Graf Zeppelin* on her epoch-making return flight to Germany. While it was no secret that the giant dirigible had to refuel here for her long journey back to Friedrichshafen, it was not generally known how the special gas came to be manufactured here, who supplied the necessary raw material, and how it was made. These facts are now told by Herman Heck, chemical engineer of the Louisville Gas & Electric Company, a subsidiary of the Standard Gas & Electric Company.

Long before the *Graf Zeppelin* started on her westward journey, Dr. Hugo Eckener, her commander, communicated with the United States Navy Department to ascertain whether it would be possible to obtain in this country the fuel gas necessary to take the liner of the air back to her base on Lake Constance. This naturally led to investigations; and it developed that the Louisville Gas & Electric Company, in the production of gasoline from natural gas from the eastern Kentucky fields, obtained a by-product gas containing from 40 to 50 per cent ethane. Now ethane gas has a specific gravity of 1.04, approximately the same as that of air or of the "blau" gas with which the *Graf Zeppelin's* fuel tanks were filled for her initial transatlantic flight. The use of either blau gas or ethane gas, it might be added, simplifies the problem of compensating for loss of weight aboard the airship, as the space taken up by the fuel, after its consumption, can be filled with free air without destroying the craft's stability.

After a series of experiments, in which the Louisville Gas & Electric Company cooperated, a special plant was built at Winchester, Ky., by the Kentucky Oxygen-Hydrogen Company for the manufacture of ethane gas. The work was in charge of R. W. Bottoms, director of research for the Kentucky Oxygen-Hydrogen Company and a recognized authority on helium gas and fractionating processes. Mr. Bottoms was formerly a lieutenant in the United States Navy, and while serving in that capacity was intimately associated with the navy's helium-gas investigations.

The fractionating or separating apparatus used in the Winchester plant was devised by Mr. Bottoms—the fractionating of the different constituents of the basic material being effected under a pressure of 250 pounds and at a temperature of about —50° F. From about 3,000,000 cubic feet of by-product gas, supplied by the Louisville Gas & Electric Company, Mr. Bottoms, with the assistance of Mr. Heck, produced 1,000,000 cubic feet of ethane gas, and this was ready in plenty of time for the *Graf Zeppelin's* hurried departure late last October.

In a telegram to E. G. Luening, vice-president of the Kentucky Oxygen-Hydrogen Company, Lieut. Commander Z. W. Wicks, in charge of the fuel arrangements of the *Graf Zeppelin* on this side of the Atlantic, had this to say about the performance of the ethane gas: "Tests in German engine completely satisfactory. Germans say gas is superior and has higher calorific value than their own." This is a splendid achievement, and proves once more what big business is capable of doing when called upon to act in an emergency.



Mexico has appropriated $2,000,000 to be expended during 1929 on her stretch of the proposed Pan-American Highway, which is to reach from Canada to the extreme southern end of South America.

A Berlin chemist claims to have produced a paper that does not burn when heated to a temperature of 1,292° F. The method of manufacture is not divulged; but it is said that the cellulose fibers are subjected to chemical action during one stage in the paper-making.

An aerial cableway, 2,700 feet between terminals, is being constructed for the Michigan-California Lumber Company at Camino, Calif., to facilitate its lumbering operations. The cableway will span a canyon half a mile long and 1,200 feet deep, and is designed to carry a maximum load of 24,000 pounds of sawed lumber at a maximum speed of 1,800 feet per minute.

Western growers are seriously considering the utilization of their surplus crops of grapes, peaches, etc., and their waste fruit in the manufacture of alcohol, carbonic-acid gas, and other commercial products. The construction of several plants for this purpose is being contemplated in the San Joaquin and Sacramento valleys.

Statistics just published by the United States Department of Mines disclose that our quarries produced 95,000,000 short tons of crushed rock in 1927. This is an enormous amount; and if made into a solid highway 20 feet wide and 1 foot thick would extend from the most northern point of North America down to the South Pole.

At the present time, Canada is the world's first producer of nickel, asbestos, and cobalt.

The coal fields at Shamshek, Persia, are reported to be among the richest in the world.

A way has been found to treat pine needles so as to remove their rosin and to produce what is described as "pine wool". This material is made up of strong fibers which can be woven into heavy fabrics suitable for bagging, etc.

New Jersey is said to be the only state in the Union that has worked out and made effective a uniform traffic code, something that is sorely needed throughout the country at large.

Eskimos in the northernmost part of Russia will soon be able to discard seal-oil lamps for electric light. A large hydro-electric station is to be built north of the Arctic Circle on the Kola River.

Within ten years, to be exact, since April, 1918, when the Salvage Branch of the Quartermaster Corps of the Army was organized, there has been placed to the credit of the Treasurer of the United States from the sale of waste metals, rubber, rags, bottles, hair, hides, etc., the sum of $34,105,122.

Swinging windows, hinged skylights or roof panels in buildings located in storm-swept areas will prevent much of the damage resulting from tornadoes, according to the United States Forest Products Laboratory. By placing automatic air vents in from 10 to 15 per cent of the walls and roof, the explosive effect caused by the sudden lowering of the air pressure outside of the structure will be robbed of much of its destructive force.

It may be a surprise to some of us to learn that there are today in the United States more factories engaged in the manufacture of airplanes than in automobiles.

The work of clearing cut-over forest land can be greatly facilitated by the use of the ordinary vacuum cleaner. The apparatus, by creating a forced draft, makes it possible to rapidly spread the flames in burning the blasted tree stumps.

Ice palaces we have heard of, but an ice museum is something new. Such a structure is being planned for Siberia, the region of "eternal frost", where organic elements are known to have been preserved in the ground for centuries. So housed it would be possible to keep for the benefit of future generations specimens of all the races, animals, food products, and utensils of their daily life and thus to leave to posterity a true record of the peoples and habits of our times.

Within the past twenty years Madagascar has become one of the world's important producers of graphite, her exports now totaling 15,000 tons a year. The deposits extend well-nigh over half the island, and they are said to contain an almost inexhaustible supply of that mineral.

A process for the production of artificial marble from magnesite has been developed in the central research laboratory established at Dairen by the South Manchuria Railway Company. Large deposits of this mineral are known to exist in different parts of that country.

Compressed Air Magazine

—*Founded* 1896—

Devoted to the mechanical arts in general, especially to all useful applications of compressed air and to everything pneumatic.

Business and Editorial Offices:

Bowling Green Building, No. 11 Broadway, New York City
Tel. Bowling Green, 8430

Publication Office: Phillipsburg, New Jersey

TERMS OF SUBSCRIPTION

$3 a year, U. S. A., American possessions and Mexico; all other countries $3.50 a year, postage prepaid. Single copies, 35 cents.

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EDITORIALS

SIGN POSTS FOR THE AVIATOR

EVERY community throughout the United States with a population of from 1,000 to 50,000 is being sought, in a campaign recently initiated by The Daniel Guggenheim Fund for the Promotion of Aeronautics, to make itself conspicuous from aloft so that "he that 'flies' may read" and therefore know where he is and in what direction he is going. This they can do by marking the name, together with an arrow pointing due north, on a suitable roof and on one that is not apt to be concealed by a smoke screen from a nearby chimney. Block letters in chrome yellow on a black background, and from 10 to 20 feet high, are suggested for these sign posts. This means of identification or marking is designed to supplement the existing air-route beacons that now guide the aviator during the hours of darkness when carrying postal matter over our far-flung air-mail routes.

In seeking the help of the people at large in an effort to increase the security and the efficiency of aerial navigation, HARRY F. GUGGENHEIM has said: "Sign posts of this kind for the airplane are an essential item in the safety of air transportation. The need for them has been repeatedly stressed by Col. CHARLES A. LINDBERGH as a result of his experience during his United States tour more than a year ago and in subsequent cross-country flying. In the opinion of Colonel LINDBERGH, who is a technical adviser to the fund, this system of identification represents one of the most important steps yet taken for the advancement of civil aviation."

The movement has the endorsement of the United States War and Navy departments, of the Department of Commerce, and of the Post Office Department, and deserves the whole-hearted support of the people, all of whom are directly or indirectly benefited by this new order of transportation.

HOOVER THE ENGINEER

WHEN HERBERT HOOVER first returned from Europe after the Armistice the American Institute of Mining and Metallurgical Engineers gave him a dinner at the Waldorf, in New York City. That dinner was a notable event, and was participated in by such men as Ambassador HERRICK, OSCAR STRAUS, and many others of eminence. Engineers turned out in large numbers to do honor to him who had done more than anyone else to lift the profession from grinding details to the level of a patriotic, civic work of the first order. There were nearly 1,500 partakers at that dinner.

The chairman, in introducing the guest of honor, said: "The engineer is by training and experience best fitted to steer the ship of state." This brought the audience to its feet; and the applause, led by Ambassador HERRICK, was significant inasmuch as the allusion bore close upon the presidency of the United States. HERBERT HOOVER at that time was not a candidate. Much of moment has occurred since, and today this engineer is the President-elect of the United States; and the country may congratulate itself that such is the case.

Engineering has been defined as the art of organizing and directing men, and of unfolding and utilizing the works of nature for the benefit of the human race. HERBERT HOOVER is a great organizer. He knows how to pick men who can be counted upon to do the work which he gives them to perform. This is an element of strength—perhaps the greatest element in any executive; and surely the President of the United States is an executive in the highest meaning of the term. We may confidently rely upon HERBERT HOOVER to display wisdom in putting his hand upon those best fitted for the tasks for which he will choose them, and by so doing add strength to that vast governmental organization that is called upon to promote the well-being of the Nation as a whole.

But above this genius of leadership, HERBERT HOOVER appeals because of his essentially humane characteristics. What he did in Belgium in relieving distress; what he did in Russia in feeding the poor; what he has done to save the lives of children; and his conduct of the Food Administration, have revealed his preëminent and predominant interest in the welfare of humankind. Great as his interest undoubtedly is in economic problems, still those problems rank second in importance compared with the primary needs of his fellowmen, as HOOVER views these questions.

HERBERT HOOVER is familiar with the economics of all countries; and as a master of this phase of productive effort he will, no doubt, do everything in his power to reduce waste and to promote savings in industry both in the industrial life of the United States and, by example, in the industrial life of the world at large. In his letter of acceptance, President-elect HOOVER used the word "economic" eighteen times; and who will deny that, next to human welfare, economic conditions very greatly affect the peace and the prosperity of nations.

W. L. S.

CASCADE TUNNEL COMPLETED IN RECORD TIME

THE completion of the 7.79-mile tunnel through the heart of the Cascade Range for the Great Northern Railway represents an engineering achievement that may well justify pride on the part of everyone concerned in this notable undertaking. The contract for the work was awarded to A. Guthrie & Company, Inc., of St. Paul, Minn., on November 25, 1925; and active operations in connection with the task were begun at the West Portal on December 1, 1925—such being the celerity with which the contractor attacked his momentous problem. The tunnel was officially declared finished early last month—virtually within the 3-year period specified in the contract.

The driving of the Cascade Tunnel actually called for the driving of two tunnels most of the way—that is, the main tunnel and the pioneer tunnel, which made it possible to increase the number of headings at which work could be done in advancing the main tunnel. Further, to expedite the work, a shaft 622 feet deep was sunk at Mill Creek, 2.41 miles west of the East Portal; and from that shaft headings were driven east and west. The finished single-track tunnel, lined with concrete throughout, has an internal width of 16 feet and a height of 20 feet 10 inches between the top of the rails and the underside of the ceiling arch.

In the driving of the Cascade Tunnel, a number of records were made by crews at different headings—a healthy, friendly competitive spirit being maintained throughout the whole course of the work. These records were directly due to competent leadership, skillful operators, and the utilizing of thoroughly modern air-driven rock drills, efficient explosives, and mucking machines capable of disposing of the large quantities of rock that had to be dealt with. In addition to these, the contractor provided other mechanical aids that were calculated to save time and to lighten the labor necessarily involved in so great an undertaking. All told, nearly 1,000,000 cubic yards of rock had to be excavated.

The men engaged on the job were housed in three camps; and the generous provisions made by the contractor for their comfort, convenience, and general well-being have played no small part in the successful consummation of the work. These camps proved that it was possible to keep the men and their families happy even though the camps were in some respects very much isolated.

The Cascade Tunnel represents an outlay of substantially $14,000,000, spent volun-

tarily by the Great Northern Railway Company for the benefit of its patrons.

SUBMARINE A VALUABLE AID TO SCIENTISTS

THE submarine has a record of sinister service because of the way certain undersea boats were employed during the World War, and it will help to a better attitude towards craft of this sort if we are reminded of a recent scientific use to which one of the class was put. We refer to the aid rendered by the United States submarine *S-21* in ascertaining conditions of the earth's crust in the deep waters in the neighborhood of the West Indies and of the west coast of Mexico.

The *S-21* made it possible for the scientific investigators concerned to make a number of very significant discoveries while the boat was submerged not far short of 100 feet below the surface of the sea—the craft being equipped with a number of sensitive instruments that made it practicable to determine the position and the height of subaqueous deformations indicating the upheaval of the ocean bed in a widespread direction upon a generally east and west line. By submerging the *S-21*, surface disturbances were avoided, and the readings of the instruments utilized were correspondingly that much more precise.

All told, the submarine submerged substantially half a hundred times; and the net results disclosed the existence of an extensive crustal area subject to stresses likely to induce earthquakes from time to time. That is to say, the earth's crust along the line examined evidenced instability, and the scientists concluded that it marked also a fairly continuous movement toward each other of the continents of North and South America. Comparatively small as the actual movement is, still the consequences are momentous in the light of the stupendous masses involved—any movement being sufficient to set up seismic actions that could be felt hundreds if not thousands of miles away. In brief, the same forces that induced the formations of mountains in the past are still at work in the depth of the ocean.

When the gathered data has been carefully checked and evaluated, it is not improbable that the information will ultimately lead to means by which it will be practicable to forecast earthquakes and the potentialities of such disturbances.

NEW PROTECTIVE COATING FOR PAPER CURRENCY

IMPROVED paper has so added to the strength of United States paper money that very little of it is now broken or torn in service. Most of the paper currency now withdrawn from circulation is declared unfit because of oil or grease stains, dirt, creasing, and other evidences of surface wear.

The Bureau of Standards and the Bureau of Engraving and Printing have been collaborating in an effort to prolong the service life of paper currency by giving the paper a protective coating of cellulose acetate; and this has been found to answer, on a laboratory scale, very well indeed. The solution imparts to printed surfaces an increased resistance to oil, water, and wet rubbing, without noticeably decreasing the high folding strength of the paper. This is a praiseworthy technical accomplishment; but the average citizen would be much better pleased if the experts could find ways to make his dollars go farther rather than merely to add to the length of life of the individual bills.

PRACTICAL COLOR SIMPLIFIED, by William J. Miskella, M.E. An illustrated book of 113 pages, published by Finishing Research Laboratories, Inc., Chicago, Ill. Price, $3.50.

COLOR has many finishing uses today; and judging by its display on every hand in all sorts of departments the public must be extremely responsive to the appeal thus made. Therefore, that the fundamentals of chromatic harmonies may not be violated, and that color may be employed effectively—one might say educationally, the present book has been compiled. We are satisfied that the volume will be of much value to all those that utilize color in their wares or in those mediums prepared by them to gain favor with the public. The book is well conceived, and its subject matter skillfully presented.

THE HANDWRITING ON THE WALL, by Dr. Arthur D. Little. A volume of 287 pages, published by Little, Brown & Company, Boston, Mass. Price, $2.50.

DOCTOR Little is first and foremost a chemist, and then a chemist who has devoted his life in the main to helping American manufacturers and allied industries through chemical research and chemical engineering. When he speaks or writes he brings to a focus a ripe experience having to do with many achievements—a goodly number of them of a revolutionary character. The present book is a typically Little product, and every page of it is well worth reading. His opening chapter is, in a sense, a broad summary of what the world owes to the chemist and a hint of what the chemist may yet do for it. Doctor Little gives many striking examples of the dependence of industry and social progress on scientific research; he discusses our fuel problems and the amazing "romance of carbon;" he traces the development of the chemical industry from its early beginnings; and he describes the extraordinarily varied demands which the war made upon chemists. His book closes with two essays of timely significance: one surveying our resources and the problems involved in their utilization, and the other presenting the claims and obligations of that small group of scientists who have recast civilization and who are so largely responsible for the maintenance of its progress.

CHEMICAL ENGINEERING CATALOG, 1928. A copiously illustrated volume of 1,107 pages, published by The Chemical Catalog Company, Inc., New York City. Price, $3.00.

THIS is the thirteenth annual edition of the work, and, like those preceding it, should prove of value in many departments of our industrial life. The book is divided into seven sections containing, respectively, an alphabetical index; a trade-name index; a classified index of equipment and supplies; an equipment and supplies section; a classified index of chemicals and raw materials; a chemicals and raw materials section; and a technical and scientific books section.

LECTURES ON STEEL AND ITS TREATMENT, by John F. Keller. An illustrated work of 267 pages, published by Evangelical Press, Cleveland, Ohio. Price, $3.50.

THE purpose of the author in preparing the six lectures contained in the book is to assist men in the metal-trade industries to a better understanding of the basic principles that underlie the various processes of producing iron and steel tools and machinery. Realizing that the subject is so often treated in a scientific style difficult for non-technical man to grasp, Mr. Keller has set himself the task of simplifying a highly technical subject so that it would be easily comprehended by the average man having to do with iron and steel and their treatments. We think he has succeeded admirably in his undertaking.

THE NEW WAY TO NET PROFITS, by Fred W. Shibley, Vice-President Bankers Trust Company, New York City. A volume of 213 pages, published by Harper & Brothers, New York City. Price, $3.00.

THIS excellent work is designed to emphasize paths along which American producers can confidently proceed in stabilizing their business and thus lessening the difference between the crest and the hollow of the waves of prosperity. Donaldson Brown, in a foreword to the book makes these constructive points:

"Forecasting and planning are the essence of modern-day business management and are vital to industrial prosperity. The focal point of the system is the sales outlet. The flow at this point must be gaged, and every other activity must be coördinated with it. The constructive aspect of gaging and checking ultimate consumer demand is no less important than statistical observation; and various factors of influence are designed favorably to affect the consumer demand. Due to this control, American business and industry will some day approach the ideal of stabilization sufficiently to free us from the bogy of the business cycle."

A Swedish mining engineer has invented an improved method of manufacturing fire brick of a superior sort, reports the *Engineer*. The brick is very porous, resembling in texture the so called gas concrete. It is said to weigh about half as much as the fire brick in common use and to possess three times its heat resisting properties. The new type of refractory is now being made on a commercial scale.